MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXVII. JULY, 1899. No. 7

INTRODUCTION.

The MONTHLY WEATHER REVIEW for July 1899, is based on reports from about 3,000 stations furnished by paid and voluntary observers, classified as follows: regular stations of the Weather Bureau, 154; West Indian service stations, 10; cotton region stations, 127; corn and wheat region stations, 133; special river stations, 132; special rainfall stations, 48; voluntary observers of the Weather Bureau, 2,220; Army post hospital reports, 27; United States Life-Saving Service, 14; Southern Pacific Railway Company, 96; Canadian Meteorological Service, 32; Mexican Telegraphic Service, 20; Mexican voluntary stations, 7. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; the Director of the Central Meteorological and Magnetic Observatory of Mexico; Señor A. M. Chaves, Director-General of Mexican Telegraphs; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; and Capt. J. E. Craig, Hydrographer, United States Navy.

The REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local meridian is mentioned.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

No storm-signal orders or special storm warnings were issued for the United States or the West Indies during July, 1899, and no general storms of marked violence occurred within the region of observation. The month was also notably free from severe local disturbances, the most important storms of this class occurring in Nebraska, Iowa, and Wisconsin during the afternoons of the 5th and 6th.

On the 11th announcement was made by the forecast official at Portland, Oreg., that the summer type of weather, with its hot and dry north to northeast winds, had set in for the States of Oregon, Washington, and Idaho. As this type of weather is liable to injure grain east of the Cascades, the announcement was an important one to farmers and merchants. Remarks regarding the value of the river forecasts issued at Portland, Oreg., during the month will be found under the heading "Portland, Oreg., Forecast District."

In the San Francisco district no signals were displayed and no special warnings were issued. Showers which occurred in Arizona on the 10th were generally forecast, and forecasts for rain in southern California and Arizona were made for the benefit of transportation companies.

CHICAGO FORECAST DISTRICT.

There were no severe storms on the upper Lakes during the month of July, and consequently no wind-signal warnings were issued.

The Chicago district during the month of July was also remarkably free from destructive local disturbances as the only storms of this character noted occurred in Nebraska, Iowa, and Wisconsin on the afternoons of the 5th and 6th, which was during the passage of a low pressure area that crossed the Rocky Mountains in Colorado on the morning of the 5th, and then slowly moved easterly over Nebraska and Wisconsin, to finally disappear four days later off the New England coast.

Showers and thunderstorms were forecast on the 5th and 6th for the States in which these destructive storms occurred.—*E. A. Beals, Inspector.*

PORTLAND, OREG., FORECAST DISTRICT.

No signal orders and no frost warnings were issued during the month.

The first summer type of weather conditions was not announced until the 11th inst., and since that date fairly pure types have prevailed. The value of such announcement has been proved this year by frequent requests by farmers and others for information on this subject. Many persons have become educated to an understanding of the term and the

resultant weather. The hot, dry north to east winds which do so much damage to the grain crop east of the Cascades, do not occur until after the summer type of weather conditions appears; this fact is gradually becoming known among the farmers east of the Cascades, hence the importance of such information to the farmers as well as to the merchants.

Rain forecasts were issued on several days and they were verified in every instance.

The valuable work of the month was the river forecasts, which were continued until the close of the month. Daily river bulletins were discontinued on the 15th. The value of the river forecasts is shown by the following extracts made from a few of the many letters received:

Boyd & Arnold, Portland, Oreg.:

* * * And testify to the uniform correctness of your forecasts, which we verified daily, while we feared the water would reach our office, but when you, June 19, stated that "there is practically no danger of Front street being flooded," we had full faith and discontinued our measurements. We appreciate the value the river bulletins are to our business men.

T. M. Sinclair & Co., Portland, Oreg.:

We desire to acknowledge the benefit we have received from the very accurate information contained therein, and the timely warnings which prevented any loss to ourselves. The bulletin is useful also in preventing its readers in going to much unnecessary expense in the removal of goods, as the precise data inspire confidence which the vivid imaginings of the old timer and river men can not upset.

Simonds Manufacturing Co., Portland, Oreg.:

We wish to congratulate you on the splendid way in which you have conducted the River Bulletin service. It has proved a great help to us; we have been able to make our plans with a greater degree of certainty than ever before.

R. Scott, Milwaukee, Oreg. (Farmer):

I found the river bulletins to be very useful, as I own land which overflows.

Meyer, Wilson & Co., Portland, Oreg.:

The bulletins have been of great service to us in that we have been saved considerable worry, if not large expense. We always have large stocks of salt, cement, etc., easily damaged or destroyed by water, stored on the docks and we would have to move same, when a flood is threatened, were it not for the information contained in your river bulletins.

Willamette Tent and Awning Co., Portland, Oreg.:

They have been of great value to us, as we carry a large stock, and your bulletins have informed us as to what we could expect regarding the high water, and thus make arrangements in time to prevent an enormous loss. The bulletins are certainly appreciated and they are of big value to every merchant in Portland and vicinity.

Henry Everding, Portland, Oreg.:

Your accurate River Bulletins have been of great value to us.

B. S. Pague, Forecast Official.

SAN FRANCISCO FORECAST DISTRICT.

The month was comparatively quiet, and there was no cause for the display of signals.

The study of the vertical thermal gradient in the vicinity of San Francisco was continued, and an effort made to use the data in daily forecasts of temperature changes for the Sacramento Valley.

On July 10 showers occurred in Arizona, New Mexico, and northwestern Texas which were generally forecast. The low central over Arizona moved slowly northward as anticipated, and warnings of rain along the valley of the Colorado were issued. During the middle of July rains were frequent over Arizona. On July 18 a thunderstorm occurred at Yuma with a maximum wind velocity of 42 miles from the north.

An attempt was made to furnish warnings of these Sonora rains to the transportation companies running through Arizona, New Mexico, and southern California. The following extract is from a letter from the general manager of the Santa Fe route:

The great difficulty, so far as washouts are concerned, is that the washouts have not been occasioned so much by the rain falling in the immediate vicinity of our tracks as from rain falling on other portions of the watershed. In this mountainous country the water comes down in torrents with the greatest of velocity, and frequently causes washouts in very high portions of the watershed. The water, instead of seeking the natural fall of the land, frequently takes the highest portions. This has been the history of the majority of our washouts west of the Rockies. Predictions as to storms in such cases are, of course, of little advantage to us, as we are never able to tell where the water will damage us.

Alexander G. McAdie, Forecast Official.

AREAS OF HIGH AND LOW PRESSURE.

During the month there were six highs and seven lows, traced on Charts I and II. As usual in the summer months, it has been very difficult to definitely locate the centers of these high and low areas, and it should be noted that the phenomena are not anything like as clearly defined as the charts seem to show.

The accompanying table gives the principal facts regarding the origin and development of these areas of high and low pressure, and the following general remarks are added:

Highs.—One of the highs, No. V, began upon the north Pacific coast, and the remaining five were first noted to the north of Montana, or in the extreme northwest. The general tendency was toward the east. No. I was last seen in Ontario, No. III in Illinois, and the remainder disappeared off the middle or north Atlantic coasts.

Lows.—Nos. I, V, and VII were first noted to the north of Montana, Nos. III, IV, and VI in the middle Plateau region, and No. II in Illinois. The general tendency was to the east and northeast, and all disappeared off the north Atlantic or in the Gulf of St. Lawrence.

The highest winds of the month were as follows: On the evening of July 7 Cleveland reported a northwest wind of 52 miles an hour. The next evening Cape May experienced a south wind of 38 miles. On the morning of the 9th Cleveland reported northwest 44 miles. On the evening of the 12th New York City had a northwest wind of 40 miles, and on the evening of the 27th the same station reported a northwest wind of 52 miles an hour.—*H. A. Hazen, Professor.*

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	4, a. m.	53	105	6, p. m.	48	82	1,080	2.5	432	18.0
II	6, a. m.	54	109	12, a. m.	44	63	3,060	6.0	510	21.2
III	14, p. m.	47	114	18, p. m.	40	92	1,530	4.0	382	15.9
IV	20, p. m.	48	92	25, p. m.	45	58	2,370	5.0	474	19.8
V	23, a. m.	49	124	28, p. m.	38	73	2,820	5.5	513	21.4
VI	27, p. m.	53	117	†1, p. m.	41	67	3,150	5.0	630	26.2
Total							14,010	28.0	2,941	122.5
Mean of 6 paths							2,335		490	20.4
Mean of 28.0 days									500	20.8
Low areas.										
I	*30, p. m.	53	104	3, a. m.	48	57	2,130	2.5	852	35.5
II	4, p. m.	43	90	7, a. m.	44	68	1,140	2.5	456	19.0
III	4, p. m.	41	110	10, p. m.	51	65	3,030	6.0	505	21.0
IV	13, p. m.	38	102	19, a. m.	50	59	2,280	5.5	415	17.3
V	16, p. m.	54	117	21, p. m.	46	69	2,250	5.0	450	18.7
VI	19, p. m.	44	115	26, p. m.	48	69	2,390	7.0	341	14.2
VII	26, p. m.	54	112	31, a. m.	48	63	2,260	4.5	502	20.9
Total							15,490	33.0	3,521	146.6
Mean of 7 paths							2,211		503	20.9
Mean of 33.0 days									469	19.5

*June. †August.

RIVERS AND FLOODS.

Water stages entirely satisfactory to the navigation interests were general during July, with more than the usual amount of water for the time of year in the Mississippi and Missouri rivers, although the tendency in the former was toward a steady decline.

The numerous and frequently heavy showers of the early days of the month in the Missouri Valley, particularly over the lower portion, caused a rise in the lower river which occasioned danger-line stages at St. Joseph and Kansas City, lasting at the latter place from the 6th to the 12th, inclusive, with a maximum stage of 22.2 feet on the 9th, 1.2 foot above the danger line. The only effect in the Mississippi of this rise was a temporary retardation of the fall from Alton southward.

In another portion of this REVIEW will be found a full report of the great Brazos River flood of June and July, 1899, from the pen of Dr. I. M. Cline, Official in Charge of the Weather Bureau Office at Galveston, Tex.

The highest and lowest water, mean stage, and monthly range at 125 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on the accompanying chart. The stations selected for charting are: Keokuk, St. Louis, Cairo, Memphis, Vicksburg, and New Orleans on the Mississippi; Cincinnati, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*F. W. Krichelt, Weather Bureau.*

Heights of rivers referred to zeros of gages, July, 1899.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	1,957	14	8.7	1,2	4.0	31	6.0	4.7
Reads Landing, Minn	1,887	12	6.5	1	2.4	31	4.2	4.1
La Crosse, Wis	1,822	12	8.9	1	3.9	30,31	6.2	5.0
North McGregor, Iowa	1,762	18	10.7	1	3.4	31	6.8	7.3
Dubuque, Iowa	1,702	15	11.7	1	3.6	31	7.2	8.1
Leclaire, Iowa	1,612	10	8.5	1	2.5	31	5.1	6.2
Davenport, Iowa	1,596	15	11.0	1	3.4	31	6.4	7.6
Muscatine, Iowa	1,565	16	12.8	1	4.4	31	8.1	8.4
Galland, Iowa	1,475	8	6.5	1	2.0	31	4.1	4.5
Keokuk, Iowa	1,466	14	11.8	1	3.3	31	7.3	8.5
Hannibal, Mo	1,405	17	13.3	1	4.8	31	8.9	8.5
Grafton, Ill	1,307	23	14.6	5,6	6.3	31	11.0	8.3
St. Louis, Mo	1,264	30	23.9	12	14.1	31	20.3	9.8
Chester, Ill	1,189	36	18.9	13	10.9	31	15.9	8.0
Memphis, Tenn	843	33	16.5	11	11.8	31	14.8	4.7
Helena, Ark	767	42	23.3	1,17	18.0	31	21.7	5.3
Arkansas City, Ark	635	42	26.2	1	22.5	27,31	24.0	3.7
Greenville, Miss	595	42	22.0	1	18.4	28,31	19.7	3.6
Vicksburg, Miss	474	45	26.7	1	20.7	29	22.4	6.0
New Orleans, La	108	16	10.0	1	5.8	31	6.9	4.2
Missouri River.								
Bismarck, N. Dak	1,201	14	11.9	7,8	6.8	31	9.8	5.1
Pierre, S. Dak	1,006	14	10.9	4,7-9	7.3	31	9.6	3.6
Sioux City, Iowa	676	19	14.0	1	10.7	31	12.6	3.3
Omaha, Nebr	561	18	14.2	2,3	11.1	31	13.0	3.1
Plattsmouth, Nebr	533	17	11.1	3	7.8	31	9.6	3.3
St. Joseph, Mo	373	10	10.1	3	7.0	31	8.8	3.1
Kansas City, Mo	280	21	22.2	9	16.1	28	19.4	6.1
Boonville, Mo	191	20	18.1	10	13.3	30	15.9	4.8
Hermann, Mo	95	24	17.8	11	12.5	31	15.5	5.3
Des Moines River.								
Des Moines, Iowa	150	19	5.2	1	3.6	30,31	4.1	1.6
Illinois River.								
Peoria, Ill	135	14	6.2	20,21	3.8	2,3	4.9	2.4
Youghiogheny River.								
Confluence, Pa	59	10	4.0	9	1.0	25	1.8	3.0
West Newton, Pa	15	23	3.9	18	0.5	6,26	1.3	3.4
Allegheny River.								
Warren, Pa	177	7	1.0	17,19	0.3	9-12	0.6	0.7
Oil City, Pa	123	13	2.3	18	0.5	7,8	1.2	1.8
Parkers Landing, Pa	73	20	3.0	18	1.0	8,11,15	1.4	2.0
Monongahela River.								
Weston, W. Va	161	18	0.0	1,19	— 0.9	11-16,28	—0.5	0.9
Fairmont, W. Va	119	25	3.0	31	0.5	13,14	1.1	2.5
Greensboro, Pa	81	18	8.7	18	6.7	26-30	7.4	2.0
Lock No. 4, Pa	40	28	10.5	18,19	6.2	13	8.2	4.3
Conemaugh River.								
Johnstown, Pa	64	7	2.1	1	1-3	26	1.7	0.8
Red Bank Creek.								
Brookville, Pa	35	8	1.8	17	0.2	27	0.7	1.6
Beaver River.								
Ellwood Junction, Pa	10	14	0.9	1	— 0.2	28-31	0.1	1.1
Great Kanawha River.								
Charleston, W. Va	61	30	7.0	1,4,29,30	6.5	7,25	6.8	0.5

Heights of rivers referred to zeros of gages—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
New River.	*Miles.*	*Feet.*	*Feet.*				*Feet.*	*Feet.*
Hinton, W. Va	93	14	2.1	29	1.3	17	1.6	0.8
Cheat River.								
Rowlesburg, W. Va	36	14	3.5	18	0.8	29,30	2.3	2.7
Ohio River.								
Pittsburg, Pa	966	22	6.8	18	2.8	22,23	5.3	4.0
Davis Island Dam, Pa	960	25	7.9	19	2.6	16	4.1	5.3
Wheeling, W. Va	875	36	8.4	20	2.8	16,17	4.7	5.6
Parkersburg, W. Va	785	36	8.8	21	4.2	10	6.0	4.6
Point Pleasant, W. Va	703	39	7.6	22	3.2	10-13	4.5	4.4
Catlettsburg, Ky	651	50	9.4	22	3.4	14	5.5	6.0
Portsmouth, Ohio	612	50	10.1	23	4.9	13	6.8	5.2
Cincinnati, Ohio	499	50	11.0	1	6.5	14,15	8.4	4.5
Louisville, Ky	367	28	5.8	1	3.8	16,18	4.8	2.0
Evansville, Ind	184	35	8.3	1	4.3	20	6.2	4.0
Paducah, Ky	47	40	8.4	8	4.7	24	7.0	3.7
Cairo, Ill	1,073	45	22.5	9,14	17.1	31	20.4	5.4
Muskingum River.								
Zanesville, Ohio	70	20	8.1	17	5.9	6,7,25	6.5	2.2
Miami River.								
Dayton, Ohio	69	18	1.5	17,26,29	0.7	5-7	1.1	0.8
Wabash River.								
Mount Carmel, Ill	50	15	2.3	1,2	1.0	16,17	1.6	1.3
Licking River.								
Falmouth, Ky	30	25	1.7	1	0.8	14-16	1.2	0.9
Clinch River.								
Speers Ferry, Va	156	20	1.5	27	0.0	16	0.4	1.5
Clinton, Tenn	46	25	5.5	29	3.3	10,11; 17,18	3.9	2.2
Tennessee River.								
Knoxville, Tenn	614	28	2.1	29	— 0.6	16,17	0.0	2.7
Kingston, Tenn	534	25	1.6	1	0.3	15,16	0.8	1.3
Chattanooga, Tenn	430	33	5.2	31	1.8	18	2.8	3.4
Bridgeport, Ala	390	24	2.5	30,31	0.1	16	1.2	2.4
Florence, Ala	220	16	2.2	28	0.5	19-21	1.2	1.7
Riverton, Ala	190	25	2.1	28	— 0.7	21	0.5	2.8
Johnsonville, Tenn	94	21	3.6	30	1.3	21-23	2.2	2.3
Cumberland River.								
Burnside, Ky	434	50	3.0	25	0.9	16	1.5	2.1
Carthage, Tenn	257	30	4.5	28	0.6	17,18,20	1.7	3.9
Nashville, Tenn	175	40	6.7	26,27,31	1.1	19-20	2.8	5.6
Arkansas River.								
Wichita, Kans	720	10	5.5	24	1.9	16-19	2.9	3.6
Webbers Falls, Ind. T	407	23	12.7	12,13	4.2	4,5,7	7.9	8.5
Fort Smith, Ark	345	22	13.6	25	5.4	6,7	9.1	8.2
Dardanelle, Ark	250	21	13.8	26	4.4	9	8.5	9.4
Little Rock, Ark	170	23	14.4	27	5.4	10,11	9.3	9.0
White River.								
Newport, Ark	150	26	15.9	25	2.3	20,21	5.4	13.6
Yazoo River.								
Yazoo City, Miss	80	25	6.2	31	— 0.5	25	0.9	6.7
Red River.								
Arthur City, Tex	688	27	22.0	24	8.5	7,20	12.0	13.5
Fulton, Ark	565	28	22.7	25	6.4	7	11.8	16.3
Shreveport, La	449	29	22.2	27	6.1	28	8.4	16.1
Alexandria, La	139	33	10.0	1	3.4	16,17	5.9	6.6
Ouachita River.								
Camden, Ark	340	39	5.5	1	3.7	25	4.4	1.8
Monroe, La	100	40	7.1	1	1.9	23,24	3.3	5.2
Atchafalaya Bayou.								
Melville, La	100†	31	25.9	1	20.0	16,17	21.7	5.9
Susquehanna River.								
Wilkesbarre, Pa	178	14	1.0	6,7	0.0	4,31	0.2	1.0
Harrisburg, Pa	70	17	1.8	1	0.8	30,31	1.2	1.0
W. Br. of Susquehanna.								
Williamsport, Pa	85	20	1.7	21	0.3	29	0.8	1.4
Juniata River.								
Huntingdon, Pa	80	24	2.9	7	3.0	1,31	3.1	0.9
Potomac River.								
Harpers Ferry, W. Va	170	16	1.9	16	0.8	29,31	1.4	1.1
James River.								
Lynchburg, Va	257	18	0.6	9	0.0	15-24	0.2	0.6
Richmond, Va	110	12	0.3	26	—1.5	23	—0.6	1.8
Roanoke River.								
Clarksville, Va	155	12	4.6	7	1.1	17	2.4	3.5
Weldon, N. C.	90	40	13.1	29	7.4	17	8.7	5.7
Cape Fear River.								
Fayetteville, N. C.	100	38	12.8	28	2.3	3,4,23	5.1	10.5
Lumber River.								
Fairbluff, N. C.	10	6	6.0	31	0.9	4	3.1	5.1
Edisto River.								
Edisto, S. C	75	6	3.5	10	1.0	23	2.3	2.5
Pedee River.								
Cheraw, S. C	145	27	7.0	28	1.0	15,24	2.2	6.0
Black River.								
Kingstree, S. C	60	12	1.5	4-6	0.6	22-30	0.9	0.9
Lynch Creek.								
Effingham, S. C	35	12	3.7	10	2.0	23-25	2.6	1.7
Santee River.								
St. Stephens, S. C	50	12	5.8	31	—0.1	23	1.6	5.9
Congaree River.								
Columbia, S. C	37	15	2.0	28	—0.3	15	0.3	2.3
Wateree River.								
Camden, S. C	45	24	8.0	28	3.4	25	4.6	4.6
Waccamaw River.								
Conway, S. C	40	7	5.3	31	1.9	20	2.9	3.4
Savannah River.								
Calhoun Falls, S. C	.....	.....	5.0	28	2.2	21	2.8	2.8
Augusta, Ga	130	32	12.7	28	5.3	22,23	6.8	7.4
Broad River.								
Carlton, Ga	.....	.....	6.5	27	2.1	15-17, 19; 20, 22, 25	2.5	4.4

Heights of rivers referred to zeros of gages—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
	Miles.	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Flint River.								
Albany, Ga	80	20	4.1	31	0.5	16-18	1.4	3.6
Chattahoochee River.								
West Point, Ga	239	20	5.9	28	2.1	10,16	2.9	3.8
Coosa River.								
Rome, Ga	225	30	8.0	22	2.7	24	2.4	5.3
Gadsden, Ala	144	18	7.0	29	0.2	16-20	1.6	6.8
Alabama River.								
Montgomery, Ala	265	35	16.0	25	0.9	17-19	4.3	15.1
Selma, Ala	212	35	17.0	26,27	0.6	19,20	4.8	16.4
Tombigbee River.								
Columbus, Miss	285	33	0.9	29	−3.0	15-17 10-12 19,20	−2.1	3.9

Heights of rivers referred to zeros of gages—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
	Miles.	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Tombigbee River—Con.								
Demopolis, Ala	155	35	12.1	29	−2.7	20,21	−0.1	14.8
Black Warrior River.								
Tuscaloosa, Ala	90	38	9.5	29	−0.7	15-20	1.5	10.2
Columbia River.								
Umatilla, Oreg	270	25	23.6	1	16.5	31	20.5	7.1
The Dalles, Oreg	166	40	40.4	2,3	27.3	31	38.5	13.1
Willamette River.								
Albany, Oreg	99	20	5.0	1	2.2	31	3.8	2.8
Portland, Oreg	10	15	23.4	3	15.5	31	20.3	7.9
Sacramento River.								
Red Bluff, Cal	241	23	0.8	1	−0.8	30,31	−0.1	1.6
Sacramento, Cal	70	25	11.8	1	8.6	31	9.8	3.2

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

Alabama.—The mean temperature was 80.4°, or 0.4° above normal; the highest was 103°, at Decatur on the 14th and at Goodwater and Wetumpka on the 16th, and the lowest, 52°, at Gadsden on the 2d. The average precipitation was 6.76, or 1.51 above normal; the greatest monthly amount, 13.42, occurred at Montgomery, and the least, 3.05, at Riverton.—*F. P. Chaffee.*

Arizona.—The mean temperature was 83.7°, or slightly below normal; the highest was 122°, at Fort Mohave on the 25th, and the lowest, 40°, at Fort Apache on the 23d. The average precipitation was 2.39, or 0.38 above normal; the greatest monthly amount, 8.04, occurred at Fort Huachuca, and the least, trace, at a number of stations.—*W. G. Burns.*

Arkansas.—The mean temperature was 79.0°, or 1.1° below normal; the highest was 100°, occurring at several stations on different dates, and the lowest, 52°, at Keesees Ferry and Witts Springs on the 10th. The average precipitation was 5.14, or 1.97 above normal; the greatest monthly amount, 10.12, occurred at Lonoke, and the least, 0.97, at Warren.—*E. B. Richards.*

California.—The mean temperature for the State, obtained by weighting the reports from 284 stations, so that equal areas have about the same weight, was 77.9°, or 1.1° below the normal for the State, as determined from 202 records; the highest was 123°, at Volcano Springs on the 2d, and the lowest, 25°, at Bodie on the 31st. The average precipitation for the State, as determined by the records of 300 stations, was trace; the deficiency, as indicated by reports from 202 stations which have normals, was 0.04 of an inch; the greatest monthly precipitation was 1.00, at Needles, while none fell at many stations.—*Alexander G. McAdie.*

Colorado.—The mean temperature was 66.7°, or 1.3° below normal; the highest was 105°, at Lamar on the 5th, and the lowest, 29°, at Troutvale on the 5th. The average precipitation was 3.01, or 0.71 above normal; the greatest monthly amount, 7.06, occurred at Santa Clara, and the least, 0.18, at Grand Junction.—*F. H. Brandenburg.*

Florida.—The mean temperature was 80.9°, or about normal; the highest was 102°, at De Funiak Springs on the 18th, and the lowest, 61°, at Wausau on the 3d. The average precipitation was 8.88, or 2.28 above normal; the greatest monthly amount, 24.45, occurred at Manatee, and the least, 3.21, at Tallahassee.—*A. J. Mitchell.*

Georgia.—The mean temperature was 80.2°, or about normal; the highest was 106°, at Albany on the 17th, and the lowest, 50°, at Clayton on the 2d. The average precipitation was 4.53, or 1.34 below normal; the greatest monthly amount, 8.05, occurred at Tallapoosa, and the least, 1.88, at Camak.—*J. B. Marbury.*

Idaho.—The mean temperature was 68.2°, or 1.8° above normal; the highest was 111°, at Hagerman on the 18th, and the lowest, 26°, at Swan Valley on the 1st. The average precipitation was 0.35, or 0.38 below normal; the greatest monthly amount, 1.36, occurred at Burnside, while none fell at Idaho City.—*S. M. Blandford.*

Illinois.—The mean temperature was 75.3°, or about normal; the highest was 101°, at Alexander on the 26th, and the lowest, 40°, at Chemung and Lanark on the 30th. The average precipitation was 3.74, or 0.20 above normal; the greatest monthly amount, 9.84, occurred at Equality, and the least, 0.71, at Charleston.—*C. E. Linney.*

Indiana.—The mean temperature was 75.0°, or about normal; the highest was 101°, at Fairmount on the 23d, and the lowest, 42°, at Columbia City, Hector, and Salem on the 9th. The average precipitation was 3.28, or 0.15 above normal; the greatest monthly amount, 6.00, occurred at Scottsburg, and the least, 0.55, at Vevay.—*C. F. R. Wappenhans.*

Iowa.—The mean temperature was 73.1°, or about normal; the highest was 101°, at De Soto on the 23d, and the lowest, 38°, at Mason City on the 30th. The average precipitation was 3.07, or about 0.50 below normal; the greatest monthly amount, 8.66, occurred at Lenox, and the least, 0.42, at Whitten.—*J. R. Sage, Director; G. M. Chappel, Assistant.*

Kansas.—The mean temperature was 76.2°, or 1.8° below normal; the highest was 106°, at Ulysses on the 7th, and the lowest, 45°, at Fanning on the 8th. The average precipitation was 5.32, or 1.70 above normal; the greatest monthly amount, 11.44, occurred at Independence, and the least, 1.21, at Medicine Lodge.—*T. B. Jennings.*

Kentucky.—The mean temperature was 77.3°, or about normal; the highest was 100°, at Princeton and Shelbyville on the 15th, at Paducah and Williamsburg on the 16th, and at Bardstown on the 17th; the lowest, 47°, at Loretto on the 10th. The average precipitation was 3.78, or 0.72 below normal; the greatest monthly amount, 7.41, occurred at Russellville, and the least, 0.97, at Lexington.—*H. B. Hersey.*

Louisiana.—The mean temperature was 82.7°, or 0.6° above normal; the highest was 105°, at Liberty Hill on the 31st, and the lowest, 54°, at North Louisiana Experiment Station, Calhoun, on the 5th. The average precipitation was 3.54, or 1.94 below normal; the greatest monthly amount, 7.30, occurred at Sugar Experiment Station, and the least, 0.37, at Minden.—*W. T. Blythe.*

Maryland and Delaware.—The mean temperature was 76.2°, or about normal; the highest was 100°, at Boettcherville, Boonsboro, and Hancock, Md., on the 22d, and the lowest, 37°, at Deerpark, Md., on the 2d. The average precipitation was 4.23, or 0.07 below normal; the greatest monthly amount, 8.37, occurred at Seaford, Del., and the least, 0.92, at Smithsburg, Md.—*F. J. Walz.*

Michigan.—The mean temperature was 68.4°, or 1.2° below normal; the highest was 100°, at Battle Creek on the 24th, and the lowest, 30°, at Rockland on the 31st. The average precipitation was 3.62, or 1.12 above normal; the greatest monthly amount, 10.62, occurred at Big Rapids, and the least, 0.80, at Newberry.—*C. F. Schneider.*

Minnesota.—The mean temperature was 70.2°, or about normal; the highest was 100°, at Milaca on the 12th and at Beardsley on the 19th, and the lowest, 36°, at Tower on the 16th, at Mount Iron on the 29th, and at Roseau on the 30th. The average precipitation was 2.84, or about 0.50 below normal; the greatest monthly amount, 9.63, occurred at New Folden, and the least, 0.47, at New Ulm.—*T. S. Outram.*

Mississippi.—The mean temperature was 81.3°, or about normal; the highest was 103°, at Westpoint on the 14th, 17th, and 18th, and the lowest, 52°, at Okolona on the 31st. The average precipitation was 4.89, or about 1.00 above normal; the greatest monthly amount, 10.49, occurred at Batesville, and the least, 1.72, at Briers.—*H. E. Wilkinson.*

Missouri.—The mean temperature was 76.1°, or about 1.0° below normal; the highest was 102°, at Princeton on the 25th and at Vichy on the 27th, and the lowest, 43°, at Potosi on the 1st. The average precipitation was 4.66, or slightly above normal; the greatest monthly amount, 9.39, occurred at Conception, and the least, 1.69, at Springfield.—*G. J. O'Connor.*

Montana.—The mean temperature was 66.7°, or 0.2° above normal;

the highest was 103°, at Glendive on the 17th, and the lowest, 28°, at Adel on the 1st. The average precipitation was 1.34, or 0.10 above normal; the greatest monthly amount, 5.42, occurred at Glendive, and the least, trace, at Billings.—*E. J. Glass.*

Nebraska.—The mean temperature was 73.4°, or 1.3° below normal; the highest was 106°, at Imperial and Madrid on the 25th, and the lowest, 36°, at Kennedy on the 28th. The average precipitation was 2.87, or 0.53 below normal; the greatest monthly amount, 10.85, occurred at Salem, and the least, 0.04, at Cody.—*G. A. Loveland.*

Nevada.—The mean temperature was 72.6°, or about 1.5° above normal; the highest was 110°, at Mill City on the 17th, and the lowest, 34°, at Elko on the 3d. The average precipitation was 0.14, or 0.25 below normal; the greatest monthly amount, 0.61, occurred at Ely, while none fell at several stations. Drought conditions prevailed over the State during the entire month. The ranges in most districts were seriously affected and stock had a hard struggle for existence.—*J. H. Smith.*

New England.—The mean temperature was 69.1°, or about normal; the highest was 101°, at Claremont, N. H., on the 4th, and the lowest, 33°, at Grafton, N. H., on the 1st. The average precipitation was 4.67, or normal; the greatest monthly amount, 8.84, occurred at Pittsfield, Mass., and the least, 1.99, at Nantucket, Mass.—*J. W. Smith.*

New Jersey.—The mean temperature was 74.7°, or about 2.0° above normal; the highest was 98°, at several stations on different dates, and the lowest, 38°, at Charlotteburg on the 1st. The average precipitation was 5.75, or 1.47 above normal; the greatest monthly amount, 9.02, occurred at Bridgeton, and the least, 3.34, at Cape May City.—*E. W. McGann.*

New Mexico.—The mean temperature was 73.0°, or 0.7° below normal; the highest was 106°, at Eddy on the 24th, and the lowest, 29°, at Winsors on the 12th. The average precipitation was 4.11, or 1.22 above normal; the greatest monthly amount, 10.51, occurred at Clayton, and the least, 1.00, at Eddy.—*R. M. Hardinge.*

New York.—The mean temperature was 70.3°, or 0.5° above normal; the highest was 101°, at Cedar Hill on the 3d, and the lowest, 35°, at Bolivar and New Lisbon on the 1st and at Saranac Lake on the 20th. The average precipitation was 3.72, or 0.17 below normal; the greatest monthly amount, 10.49, occurred at Port Jervis, and the least, 0.70, at Madison Barracks.—*R. G. Allen.*

North Carolina.—The mean temperature was 76.5°, or 1.0° below normal; the highest was 102°, at Rockingham and Salisbury on the 16th, and the lowest, 40°, at Linnville on the 1st. The average precipitation was 6.51, or 0.90 above normal; the greatest monthly amount, 12.15, occurred at Selma, and the least, 2.12, at Marion—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 68.3°, or 0.4° below normal; the highest was 109°, at Steele on the 21st, and the lowest, 32°, at Dunseith, on the 29th. The average precipitation was 1.88, or 0.49 below normal; the greatest monthly amount, 6.12, occurred at Sheyenne, and the least, 0.45, at Bismarck.—*B. H. Bronson.*

Ohio.—The mean temperature was 74.1°, or about normal; the highest was 105°, at Seaman on the 4th, and the lowest, 41°, at Orangeville on the 10th. The average precipitation was 4.18, or 0.22 above normal; the greatest monthly amount, 6.45, occurred at Levering, and the least, 1.51, at Vanceburg—*J. Warren Smith.*

Oklahoma.—The mean temperature was 79.8°, or about normal; the highest was 106°, at Kemp on the 13th, and the lowest, 59°, at Beaver on the 1st and Kemp on the 12th. The average precipitation was 6.05, considerably above normal; the greatest monthly amount, 14.00, occurred at Fort Sill, and the least, 1.35, at Norman—*H. L. Ball.*

Oregon.—The mean temperature was 66.1°, or about normal; the highest was 107°, at Pendleton on the 13th, and the lowest, 26°, at Silverlake on the 1st. The average precipitation was 0.15, or 0.34 below normal, the lowest on record for July; the greatest monthly amount, 1.15, occurred at Stafford, while no rain fell in several counties.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 72.3°, or 1.0° above normal; the highest was 101°, at Aqueduct on the 22d, and the lowest, 35°, at Dushore on the 1st. The average precipitation was 3.91, or nearly normal; the greatest monthly amount, 8.24, occurred at Seisholtzville, and the least, 1.53, at Lewisburg.—*T. F. Townsend.*

South Carolina.—The mean temperature was 80.0°, or about normal; the highest was 105°, at Columbia, Greenwood, and Little Mountain on the 15th, and the lowest, 47°, at Holland on the 4th. The average precipitation was 4.03, or 1.99 below normal; the greatest monthly amount, 10.16, occurred at Temperance, and the least, 1.58, at Trenton.—*J. W. Bauer.*

South Dakota.—The mean temperature was 72.4°, or about normal; the highest was 111°, at Interior on the 22d, and the lowest, 32°, at Ashcroft on the 28th. The average precipitation was 2.02, or about 0.89 below normal; the greatest monthly amount, 6.83, occurred at Canton, and the least, 0.28, at Forestburg. The precipitation was excessive over portions of Bon Homme, Clay, Lincoln, Turner, and Union counties.—*S. W. Glenn.*

Tennessee.—The mean temperature was 77.5°, or about 1.0° above normal; the highest was 101°, at Dover on the 15th and 16th, and the lowest, 44°, at Silverlake on the 9th and 10th and at Erasmus on the 10th. The average precipitation was 4.53, or about normal; the greatest monthly amount, 7.58, occurred at Lafayette, and the least, 1.61, at Covington.—*H. C. Bate.*

Texas.—The mean temperature, determined by comparison of 42 stations distributed throughout the State, was 0.6° below the normal; there was a slight excess for the month in a few scattered localities and a general deficiency elsewhere; the highest was 110°, at Desdimonia on the 23d, and the lowest, 44°, at Marathon on the 10th. The average precipitation, determined by comparison of 48 stations distributed throughout the State, was 0.44 above the normal. There was a general excess ranging from 1.00 to 5.19 over west Texas, the Panhandle, the western portion of north Texas, the eastern portion of southwest Texas, and in Galveston, Brazoria, and Fort Bend counties, with the greatest at Wichita Falls. Over the other portions of the State there was a general deficiency, with the greatest over the eastern portion, where the deficit ranged from 1.00 to 2.00. The rainfall was very unevenly distributed over the State. The greatest monthly amount, 12.70, occurred at Alvin, while none fell at several stations.—*I. M. Cline.*

Utah.—The mean temperature was 73.3°, or 1.0° above normal; the highest was 107°, at St. George on the 1st and 27th, and the lowest, 30°, at Woodruff on the 23d. The average precipitation was 0.66, or 0.01 above normal; the greatest monthly amount, 3.07, occurred at Grover, and the least, trace, at Blue Creek, Croydon, and Ogden. On the evening of the 11th a flood, produced by heavy rain or a cloudburst in the mountains, swept down Manti Canyon, struck Manti, which is located at the foot of the canyon, and damaged buildings and other property to the extent of about $25,000 or $30,000.—*L. H. Murdoch.*

Virginia.—The mean temperature was 75.7°, or about 1.0° above normal; the highest was 101°, at Doswell on the 22d, and the lowest, 35°, at Hot Springs on the 10th. The average precipitation was 4.48, or slightly in excess of the normal; the greatest monthly amount, 10.41. occurred at Sunbeam, and the least, 1.42, at Clifton Forge.—*E. A. Evans.*

Washington.—The mean temperature, was 66.1°, or about 1.5° above normal; the highest was 112°, at Lind on the 16th, and the lowest, 32°, at Colfax on the 23d. The average precipitation was 0.36, or 0.26 below normal, or about 58 per cent of the normal amount; the greatest monthly amount, 1.59, occurred at Coupeville, while none fell at Centerville, Connell, Lyle, and Sunnyside.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 73.3°, or 0.6° above normal; the highest was 100°, at Uppertract on the 22d, and the lowest, 33°, at Terra Alta on the 10th. The average precipitation was 3.78, or 0.89 below normal; the greatest monthly amount, 7.92, occurred at Philippi, and the least, 0.20, at Beckly.—*C. M Strong.*

Wisconsin.—The mean temperature was 70.3°, or nearly normal; the highest was 102°, at Medford on the 25th, and the lowest, 34°, at the same station on the 30th. The average precipitation was 3.19, or 0.13 above normal; the greatest monthly amount, 7.60, occurred at Gratiot, and the least, 0.75, at Medford.—*W. M. Wilson.*

Wyoming.—The mean temperature was 65.6°, or 1.0° below normal; the highest was 108°, at Bittercreek on the 25th, and the lowest, 28°, at Rock Springs on the 3d and at Burns on the 23d and 29th. The average precipitation was 1.28, or slightly above normal; the greatest monthly amount, 3.28, occurred at Cheyenne, and the least, 0.07, at Wamsutter.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

COLD WAVES IN THE SOUTHWEST.

J. S. HAZEN, Observer, Weather Bureau.

The remarkable, intense, and far-reaching cold waves of the past winter, culminating in that phenomenal and record-breaking cold wave of February 11–14, 1899, gave lower temperatures in many sections than had ever been known, and has done much to bring the work of the Weather Bureau before the people, and to give an impetus to the study of the phenomena attending such storms.

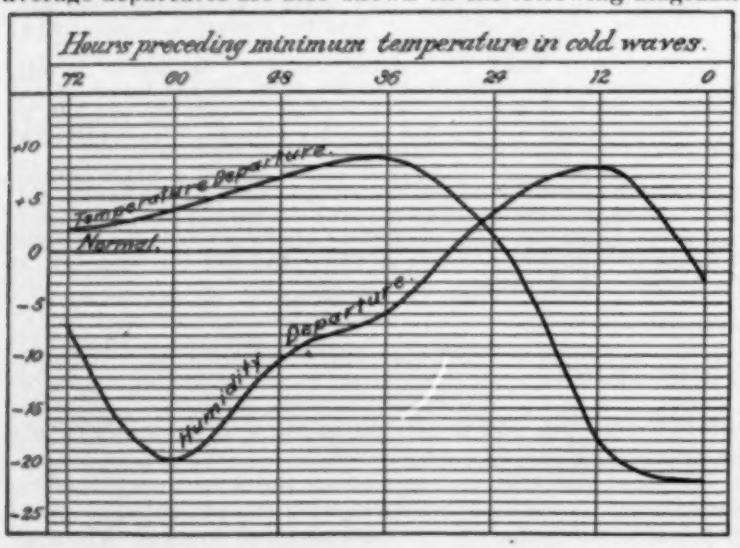
The local and visible conditions or premonitions preceding a cold wave in the Southwest are, with the possible exception of the relative humidity, uniform and well known. The first, and absolutely essential element, is an area of low barometric pressure in the Southwest. This low area may develop in the Southwest, or move down the eastern slope of the Rocky

Mountains, or may come from the Gulf and unite with a disturbance from the Southwest. Such a condition naturally gives to the southwest section of the Mississippi watershed several days of southerly winds, and temperatures much above the seasonal normal. The atmospheric moisture will also be drawn into this section by the southerly winds, until it attains a large excess over the monthly normal. There may or may not be precipitation preceding the crest of the cold wave, but usually some sections of the area involved will receive a portion of the surplus moisture in the form of rain or snow. Those who encountered the cold waves of the past winter need not be told of the suddenness with which a warm, brisk breeze from the south or southwest can shift to the northwest and the temperature begin its rapid descent toward the zero point.

There is one point, however, which is not so noticeable; this is the element of relative humidity. There is apparently a low and a high humidity. The low usually, if not always, precedes the advance of the area of low pressure, and the high humidity is considerably in advance of the high pressure area. The visible signs of a low humidity are not well marked, but an increase in the relative percentage of moisture in the atmosphere is very conspicuous. Every one who has observed carefully the conditions preceding a sudden change in temperature, must have remarked the peculiar thickening appearance which the sky undergoes. There seems to be an impalpable filling up of the upper air, giving to the sky an appearance of light haze. This condition was especially noticeable preceding the cold wave of February 12 and 13, 1899. Six hours before the temperature began to fall rapidly, a dull, somber, hazy, veil-like streak was observed along the northwest horizon, which gradually increased and darkened until the entire sky was a leaden gray. From this condition, fine cirro-stratus clouds eventually formed.

The relationship existing between the pressure, temperature, and humidity elements, at the earth's surface, have been so thoroughly and systematically studied, that it seems hopeless to attempt any further researches in this line. But one line of investigation, which, in the opinion of the writer, is more than usually promising, is the relation between the humidity crest, the temperature crest, and the pressure crest.

Instead of publishing the sixteen examples in full the following table shows in condensed form the temperature and humidity departures for each 8 a. m. and 8 p. m. observation preceding the arrival of the lowest temperature. The general average departures are also shown in the following diagram.



A study of the departures from normal values for 8 a. m. and 8 p. m., as to temperature and relative humidity, for sixteen cold waves, indicates that there is more than a casual relation between heat waves, cold waves, and relative humidity, or moisture waves. Of course the results obtained from one station are not sufficient to predicate a theory upon, but in these sixteen examples, which were selected at random, there is a uniformity in the relationship shown, which must be more than accidental.

It will be seen that in nearly every case, the relative humidity is the element in which we first perceive a rapid and violent fluctuation; the percentage generally reaches its lowest point at, or within, a few hours of the time at which the temperature begins a rapid fall. At the period of low humidity, the greater the departure from normal humidity, the greater the fall in temperature is likely to be. The farther the low humidity is in advance of the low pressure and high temperature, the more apt we are to have a period of cold weather extending over two days or longer. The first eleven examples show that the lowest temperature occurs when the humidity is above the monthly normal. In the remaining five examples the humidity is but slightly below the normal, notwithstanding the generally accepted belief that a high pressure area is associated with dry cold air.[1] This would seem to indicate that the coldest weather closely follows a period of abnormally low humidity, followed by a rapid increase in humidity until about the time the lowest temperature occurs, when the humidity element is above normal. The downpour of cold air from the higher regions does not occur until the minimum temperature has been reached and the temperature has begun to rise.

Cold wave No. 16 shows the conditions preceding the severe cold period from February 12 to 14, when for several days the temperature and humidity were both below normal, with a general tendency of the temperature downward, but with humidity about stationary.

Temperature and humidity preceding cold waves at Springfield, Mo.

Cold wave number.	Date of arrival.	Departure from normal.												
		Temperature, degrees F.							Relative humidity, per cent.					
		Hours in advance.							Hours in advance.					
		72	60	48	36	24	12	0	72	60	48	36	24	12	0
1	1891, Dec. 26, a. m.	+ 0	+ 1	+ 1	+ 5	+13	−22	−23	+11	+17	+16	−14	−10	+24	+11
2	1898, Dec. 31, a. m.	+10	+20	+18	+25	− 6	−18	−19	− 6	−35	−32	− 8	+ 5	− 2	−17
3	1898, Nov. 22, a. m.	+ 4	+12	+14	+20	+19	−32	−14	− 9	−30	−20	−20	+12	− 4	− 8
4	1897, Nov. 23, a. m.	+ 9	+17	+21	+20	+ 3	−13	−16	−31	−40	− 1	0	+10	+ 9	−12
5	1897, Jan. 25, a. m.	+ 9	0	− 1	+15	−19	−29	−26	− 6	−13	+ 2	−17	− 4	+ 7	− 5
6	1896, Jan. 3, a. m.	− 2	+ 5	+ 1	+ 5	+13	−14	−26	− 1	−19	−28	−19	−23	− 2	+ 3
7	1894, Feb. 20, a. m.	+19	+ 2	+ 2	+14	+ 1	− 8	−10	+ 1	+16	+11	−16	+ 3	+ 9	+ 9
8	1894, Jan. 24, a. m.	+12	−11	− 1	− 5	0	−27	−45	+12	−12	+11	+ 5	+ 8	+20	+ 7
9	1893, Dec. 16, a. m.	− 3	− 9	+ 6	+16	+25	− 9	−18	−38	− .1	−14	+ 2	+22	− 9	+ 1
10	1893, Jan. 13, a. m.	−13	− 7	+ 3	− 4	− 8	− 9	−23	− 5	−18	0	− 3	+ 5	+ 6	0
11	1892, Jan. 19, a. m.	− 3	0	+ 4	0	−15	−26	−31	− 4	−12	− 5	+20	+ 9	+18	−17
12	1893, Feb. 15, a. m.	− 8	−14	− 7	− 9	− 5	−13	−24	+ 7	−14	+ 3	+28	+ 5	+ 2	+ 7
13	1895, Jan. 12, a. m.	−14	0	0	− 2	+ 5	−17	−35	+ 4	−22	−10	−28	+ 3	−12	−21
14	1892, Feb. 15, a. m.	−12	+ 3	+ 9	+10	− 1	−16	−14	+ 5	−30	−47	+ 3	−13	−11	− 2
15	1892, Mar. 14, p. m.	+ 5	+16	+ 8	− 2	− 4	−20	−13	−23	−35	−16	−11	+12	+19	+ 6
16	1899, Feb. 9, a. m.	− 7	−13	−13	−16	−19	−26	−32	+11	− 9	−24	−18	− 6	−24	−12
	Average departure	+ 2	+ 4	+ 6	+ 8	+ 2	−19	−22	− 6	−20	− 9	− 7	+ 5	+ 8	− 5

CONCLUSIONS.

1. Preceding cold waves, with temperature above normal,

[1] The general idea that dry cold air is associated with high barometric pressures is probably quite correct, no matter whether we consider the absolute humidity or the percentage of relative humidity. The apparent exception noted by Mr. Hazen occurs generally during the early morning hours and near the ground, at which time and place the local temporary temperature is so low that a high relative humidity, and even fog, may be observed. At the same place, in the middle of the day, a very low relative humidity will be observed without any corresponding change in the absolute humidity. As the relative humidity depends on both moisture and temperature, the air that is cold and foggy for an early morning temperature of −10° F. becomes cold and dry in a midday temperature of 0° or + 10° F., and very dry when still further warmed up during the next few hours.—ED.

there is a low humidity, which is in advance of, or coincident with, the fall in temperature.

2. The lower the humidity falls and the more violent its fluctuations, the greater will be the fall in temperature.

3. The earlier the low humidity reaches the station in advance of the fall in temperature, the longer will the period of cold last.

4. Coincident with, or shortly before the lowest temperature, the humidity usually attains a value above normal and begins to fall as the temperature begins to rise.

EVERY MAN HIS OWN WEATHER PROPHET.

By J. HOWARD HOPKINS, Ruxton, Md. (dated July 25, 1899).

The rules laid down under the above title by the Baltimore Trade have been examined by me with the following results:

The assertion that the extreme cold spells of the winter are just six months after the hottest spells of summer does not, except in one or two instances, at all agree with my own observations. I have been keeping private records for the past four or five years, making temperature my principal observation. The warmest periods of weather for June, July, and August, 1895, were certainly not followed in six months by the coldest weather for December, January, and February, respectively. To be sure it was moderately cool for the season during the first few days of December, 1895, but it was by no means the complement of the corresponding days of June, when the temperature was remarkably high for the season. The warmest period of September of that year, it is true was followed by a severe cold spell in March, but might not this have happened by mere chance? In 1896, only the cold wave of the following January corresponds to the warm period of July; June, August, and September had no cold waves during the next winter to follow their warmest periods.

In 1897 I can find nothing at all that confirms the truth of the Baltimore Trade rule.

As for 1898, December shows no cold waves that correspond to the hot weather which prevailed from June 24 to 28. January, 1898, had a severe cold wave, corresponding with the extreme heat of July 1–4 preceding, but the great cold spell of February 9–15, 1898, had no complementary hot period in August, 1897. September, 1898, had a hot spell, which was followed in March, 1899, by a period of rather cool weather but the coolness was not to be compared with the preceding excessive heat.

As regards the statements that the last week in March determines the character of the last week in September, and, that if the weather from March 22 to the end of the month is warm, there will be great danger of frosts during the last week in September, or vice versa—I find my records agree no better with this than in the previous cases, and my records are kept quite as accurately as is practicable.

A STUDY OF TEMPERATURES AT BALTIMORE, MD.

By F. J. WALZ, Local Forecast Official and Section Director.

In the Baltimore Sun of February 2, 1899, there appeared an editorial article stating that the Baltimore Trade had deduced a general rule for temperature forecasting, based on a study of the tables of temperature printed in the Sun Almanac for a number of years past. This rule, it is claimed, is based on statistics which show that from the record of spring and summer anomalies in temperature an inference may be had as to the fall and winter temperature anomalies which will follow just six months later in the same locality; in other words, the extremes in fall and winter conditions are the complement of the extremes in the spring and summer conditions immediately preceding, and the interval of time is almost invariably a period of six months. The statement was also made that the rule could be put to practical use, which would result in much benefit in cases where business interests were likely to be affected by temperature extremes. March 22 is given as the epoch or initial date from which calculations are to be reckoned.

The temperature tables in the Sun Almanac are furnished by the Weather Bureau office in Baltimore, and are consequently official and reliable, so that no exception can be taken to the material used in the studies made by the Trade. Acting on the suggestion of the Editor of the REVIEW, whose attention to the article had been called by Mr. Howard Hopkins, of Ruxton, Md., I have carefully examined and compared the temperature records of this station for the past seven years, beginning with March 22, 1892, with a view of proving or disproving the value of the system of long-range temperature forecasting evolved by the Baltimore Trade.

In the tables which follow the facts thus obtained are presented (1) in a summary of results secured by comparing the warm and cold periods of each month with the conditions prevailing six months later; (2) by a statement of results obtained through a comparison of the warmest and coldest days of each month with the data recorded six months later; and (3) by a table showing the absolute highest and lowest temperatures for each year and the dates of their occurrence.

An exact verification is one in which an extreme of spring or summer heat or cold during a given month is followed six months later by an extreme of the opposite nature. A partial verification is one in which the extreme is followed by its opposite to a mild degree only. A nonverification, or failure, is an instance in which the Trade rule does not hold good. And an opposite result, as given in the tables, is an instance in which an extreme thermal condition has been followed six months later by an extreme of the same order.

TABLE 1.—*Summary of results in testing Baltimore Trade long-range temperature forecast rule when applied to warm and cold spells of two or three days or more duration.*

	Exact.	Partial.	Failure.	Opposite.
March 22–31 with September 22–31	1	4	7	8
April with October	3	6	22	4
May with November	3	10	21	9
June with December	2	10	21	3
July with January	2	12	16	3
August with February	1	3	27	2
September 1–21 with March 1–21	3	6	15	6
Total	15	51	129	35

TABLE 2.—*Summary of results in testing Baltimore Trade long-range temperature forecast rule when applied to the warmest and coldest days in each month.*

	Exact.	Partial.	Failure.	Opposite.
March 22–31 with September 22–31	1	3	9	1
April with October	2	5	6	1
May with November	0	5	5	4
June with December	1	7	4	1
July with January	1	5	4	4
August with February	1	4	4	3
September 1–21 with March 1–21	2	5	3	4
Total	8	34	35	18

TABLE 3.—*Highest summer and lowest winter temperatures for each season, with dates of occurrence, since* 1892.

Highest.	°	Lowest.	°
1892, July 26	99	1893, January 16	1
1893, June 20	98	1894, February 25	8
1894, June 24	98	1895, February 6	1
1895, June 1 and 3	97	1896, February 17	5
1896, August 7	98	1897, January 26	8
1897, June 30	95	1898, February 2	10
1898, July 3	104	1899, February 10	— 7

In attributing verifying or nonverifying values in the tables above given, I have allowed a margin of one or two days, instead of limiting the possibility of a verification to the exact date six months later.

An examination of the tables readily discloses the fact that the rule laid down by the Trade affords a very unsatisfactory basis for long-range temperature forecasting, for not only does the number of failures far exceed the exact verifications, but the opposite of the rule has been found to have occurred more often than the rule for which so much is claimed.

In the article in question a number of examples were given to prove the truth of the rule. These examples were all taken from a comparison of the summer temperatures of 1898, with the winter temperatures of 1899, and at first glance might, without further examination, seem to comply with the rule and prove its accuracy to a fair degree. I therefore give a few details of the conditions obtaining during that period with reference to an application of the Trade temperature rule.

The first four days of July were excessively hot, and the third marked the highest temperature (104°) that has ever been recorded at the Baltimore station; the first three days of January were cold, especially the 2d, when the minimum temperature was 6°, which is about an average lowest temperature for winter. This, however, was far from being the coldest during the winter of 1899, for in February, from the 7th to the 16th, occurred the most severe cold spell on authentic record, when the temperature was as low as 7° below zero. No corresponding warm period occurred in August preceding, during which time, in fact, the temperature did not vary much from the normal, and was below normal on several of the days. The 29th–31st of July was very warm, as stated in the article quoted, and January 28–31 was quite cold, especially the 28th and 31st, which were 12° to 15° below normal, but did not compare in severity with the February cold period. September 1–4, 1898, was an intensely hot period, but the following March, up to the 6th, was either normal or above in temperature, though a fairly cool spell followed from the 7th to the 11th. September 18–19 was again very warm, but March, at a corresponding period, was also warm, though a very cold spell followed on the 20th and 21st.

The whole matter merits attention only from the fact that suggestions or statements of this character are easily disseminated and as easily secure a hold on the public mind. The efforts to trace a relationship between the abnormal weather conditions that have been recorded at a place are worthy of commendation, but, as is well known, the most systematic and prolonged research of skilled meteorologists has thus far failed to give other than negative results. Knowing further, as we do, that the transient pressure systems, whose formation and development certainly can not be premised months ahead, are the governing factors in the production of temperature extremes for this section of the United States at least; it becomes necessary to first define a rule to foretell the dates of their occurrence in a given locality for four, five, or six months in advance. If this could be done, the temperature prediction would accurately follow.

RECENT PAPERS BEARING ON METEOROLOGY.

W. P. R. PHILLIPS, in charge of Library, etc.

The subjoined list of titles has been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

Naturwissenschaftliche Rundschau. Braunschweig. 14 *Jahr.*
Bezold, Wilhelm von. Ueber Erdmagnetismus. P. 349.
Science. New York. Vol. 10.
Fergusson, S. P. Formation of Cumulus Clouds over a Fire. P. 86.
Zeitschrift für Luftschiffahrt und Physik der Atmosphäre. Berlin. 18 *Jahrg.*
Ritter, F. Die hebende Kraft des Windes. P. 153.
Stentzel, Arthur. Der Weg zum Ziel. P. 125.
Popper, Josef. Flugtechnische Studien. II. P. 133.
Meteorologische Zeitschrift. Wien. Band 16.
Kassner, Dr. C. Bewölkung in Europa an Cyklonen und Anticyklonen-Tagen. P. 241.
Maurer, J. Erscheinungen des Erdlichts, 1895–1899. P. 257.
Hazen, H. A. Das Problem des Psychrometers. P. 261.
—— Resultate der meteorologischen Beobachtungen in Kamerun (Gouvernement) in den Jahren 1896 und 1897. P. 264.
Supan. Vertikale temperaturabnahme in der freien Atmosphäre. P. 266.
Prohaska, K. Die tägliche Periode der Gewitter und Hagelfälle im Jahre 1897 in Steiermark und Kärnten. P. 267.
Prohaska, K. Bemerkenswerthe Entladungsformen der atmosphärischen Elektricität im Jahre 1897 in Steiermark und Kärnten. P. 268.
Polis. Die Niederschlagsverhältnisse der Rheinprovinz. P. 269.
Brucker. Wettercyklus. P. 273.
—— Resultate der meteorologischen Beobachtungen zu Port Nollath, Sud-Afrika. P. 274.
—— Klima von Puira, Peru. P. 275.
Hann, J. Review of A. Angot: Traité Élémentaire de Météorologie. P. 286.
—— Wragge's Australasian Almanac and Weather Guide for Land and Sea (Review). P. 237.
Scientific American. New York. Vol. 81.
Notes on Air Resistance. Letters from W. F. Cleveland and Robert Manchlin and editorial. P. 66 and 70.
Symon's Monthly Meteorological Magazine. London. Vol. 34.
—— Meteorological extremes. P. 81.
Hazen, H. A. Effect of the Moon on the Temperature. P. 86.
Miller, Sam'l H. Ozone. P. 90.
Brook, Chas. S. Lunar halo. P. 88.
Western Electrician. Chicago. Vol. 25.
McAdie, Alexander G. Lightning Conductors. (Extract from Weather Bureau Bulletin 26). P. 60.
Archive des Sciences Physiques et Naturelles. Genève. Tome 8.
Wartman, Dr. Aug. Coup de foudre en boule. P. 96.
Gautier, Raoul. Violent coup de foudre. P. 101.
La Nature. Paris 27*me Année.*
Jullien, O. Ciel vert émeraud. P. 114.
Plumadon, J. R. La propagation des orages. P. 138.
Comptes Rendus des Séances de l'Académie des Sciences. Paris. Tome 129.
Teisserenc de Bort, Leon. Sur les ascensions dans l'atmosphère d'enregistreurs météorologiques portés par des cerfs-volants. P. 131.
Bouty, E. Les gaz raréfiés possèdent-ils la conductivité électrolytique? P. 152.
Thierry, M. de. Dosage des gaz carbonique au mont Blanc. P. 31.
Aeronautical Journal. London. Vol 3.
Fitz-Gerald, M. F. Flapping flight of Aeroplanes. (From Proc of Royal Society). P. 59.
Merrill, J. R. Some simple Experiments with Aero-Curves. P. 65.
Das Wetter. Berlin. 16 *Jahrgang.*
Less, E. Die Wissenschaftlichen Grundlagen von Wetterprognosen für kurze und solchen für etwas längere Zeiträume. P. 145.
Polis, P. Die Niederschlags und Temperaturverhältnisse des südlichen Roergebietes im Jahre 1898. P. 153.
Clayton, H., Elias, H. Ergebnisse der Drachen-Aufstiege vom 24 und 25 November 1898 am Blue Hill Observatorium. P. 162.
Elias, H. Drachen-Experimente. P. 167.
Annales de Chemie et de Physique. Paris. 7me séries. Tome 14.
Leduc, A. Les chaleurs spécifiques des gaz et l'équivalent méca nique de la calorie. P. 484.
Ciel et Terre. Bruxelles. 20*me Année.*
Artowski, H. Résultats préliminaires des observations météorologiques faites pendant l'hivernage de la *Belgica*: I. Température de l'air. P. 245.
Ventosa, V. La direction du vent et la scintillation. (*Suite*) P. 248.
Chauvereau. La variation diurne de l'électricité atmosphérique. P. 246.
Philosophical Magazine. London. Vol. 48.
Wood, R. W. Photography of Sound-Waves by the "Schlieren-Methode." P. 218.

SPECIAL REPORT ON THE FLOOD IN THE BRAZOS RIVER VALLEY, TEXAS, JUNE 27 TO JULY 15, 1899, WITH NOTES OF PREVIOUS OVERFLOWS OF THE BRAZOS.

By I. M. CLINE, Local Forecast Official and Section Director.

The Brazos River, with its tortuous channel of nearly one thousand miles in length, passes through a narrow valley which ranges in width from a few miles to several miles in different localities. This valley is unsurpassed for productiveness. The banks of the Brazos for 200 miles from its mouth range in height from 20 to 40 feet, and in ordinary seasons are not overflowed to any serious extent. Heavy rains about its source cause the river to swell into a torrent, which flows with great impetuosity, but does not often overflow its banks. The banks of the river are formed of a tenacious red or blue clay which yields very slowly to the force of the current. The width of the channel ranges from 150 to 200 feet. The gradient of the river from Waco to the Gulf of Mexico is little more than two feet to the mile.

The recent flood resulted from heavy rains which set in near the mouth of the Brazos on the afternoon and night of June 26 and progressed slowly inland until June 28, when phenomenally heavy rains occurred over the central portion of the Brazos drainage basin. In some localities the rains were unprecedented in the history of Texas.

The heaviest rains were recorded as follows during the seventy-two hours ending 8 a. m., June 28: Alvin, 7.27 Brazoria, 7.83; Galveston, 3.20. During the seventy-two hours ending 8 a. m., June 29: Columbia, 8.06; Conroe, 7.31; Danevang, 11.07; Houston, 5.49; Rock Island, 10.15; Sugarland, 10.50; Victoria, 5.00. During the seventy-two hours ending 8 a. m., June 30: Brenham, 19.99; Cuero, 12.86; Hewitt, 14.95; Lampasas, 4.80; Panter, 7.12; Waco, 7.30. The rain gage at Hearne overflowed at 24 inches. The observer at that station estimates the amount at 30 or 40 inches in less than twenty-four hours during the 28th and early morning of the 29th. These rains were all at an elevation of less than 500 feet above sea level.

The heavy rains appear to have resulted from a semitropical storm which had moved northward from the central portion of the Gulf of Mexico. This storm was first noted on the a. m. weather map of June 26, 1899, and later in the day a high tide and heavy swell at Galveston, Tex., indicated a storm of considerable energy at sea to the south of Galveston. Storm signals were displayed at Galveston on the afternoon of June 26 as a warning that a Gulf storm was approaching. During the night of June 26 the storm moved inland and its energy had greatly diminished from that at first shown by the ocean swell. Judging from the progressive movement of the heavy rainfall, the storm died out as it moved inland at the slow rate of about five miles per hour. The heavy rainfall occurred near the coast twenty-four to thirty-six hours earlier than at Hearne and Waco. A study of the rainfall at all stations shows the progressive movement of the storm from the coast inland, notwithstanding the barometric gradients at the surface were not sufficient after the storm left the coast to indicate the position of its center on the chart. The lowest barometer recorded at Galveston during this storm was 29.74 inches, at 8 p. m., June 26. The dying storm was opposed on June 27 and 28, by an area of high pressure moving southward from the northwest. Such was the distribution of atmospheric pressure at the earth's surface during the occurrence of these rains.

The heavy rains recorded on the mornings of June 27 and 28 near the mouth of the Brazos filled all its tributaries and the main river in that section almost to the top of their banks, while the phenomenally heavy rains recorded on June 28, 29, and 30 in the central portion of the Brazos drainage basin not only filled all the tributaries of the Brazos in that section, but overflowed all low lands. On June 29 all streams in Bosque, McLennan, Falls, Milam, Robertson, Brazos, Burleson, and Washington counties were higher than ever before known, and the Brazos was rising at an unprecedented rate. The flood in these counties was the most sudden in the history of the country. The Brazos did not overflow its banks north of McLennan County. At Waco the river reached its highest on the morning of June 30 when it was within six inches of the highest water ever noted at that point; in east Waco 50 to 100 blocks were flooded. On the afternoon of June 30 the Brazos began falling at Waco, but was rising with the same rapidity and suddenness at all points south of McLennan County and north of Austin County as that which characterized the rise at Waco. On July 1 a second flood reached McLennan County, and the river rose nearly as high as it did on June 30. On July 1 and 2 the crest of the flood appears to have occupied a position near the junction of the main Brazos and Little Brazos rivers in Robertson and Brazos counties. The waters from the two rivers rose rapidly over the rich valley between them on which were large plantations with gins, stores, and residences. The waters from the two rivers joined so rapidly that some of the inhabitants did not have time to escape, and 24 lives were lost in Robertson County. The thriving town of Calvert, in this county, was cut off from communication with other portions of the State from July 1 until July 3, when communication was again restored. From this time the crest of the flood moved slowly toward the Gulf of Mexico at the rate of about twelve miles per day and disappeared in the Gulf July 15, 1899. The crest of the flood was seventeen days in passing from Waco to the mouth of the Brazos. At Richmond the water was 3 to 7 feet in all the houses on the lower streets on July 5 and 6. Small towns in Brazoria County suffered as the flood moved southward. This flood was not only marked on account of the suddenness with which it reached dangerous proportions, but it was also the most extensive flood in all respects that has ever been known in the Brazos Valley.

The following table gives the rainfall during the flood period from June 27 to July 4, inclusive:

Station.	Rainfall.	Station.	Rainfall.	Station.	Rainfall.
	Inches.		*Inches.*		*Inches.*
Abilene	5.58	Emory	5.80	Luling	4.58
Alvin	7.28	Estelle	3.54	Mann	10.08
Amarillo	0.90	Fort Brown	T.	Marathon	0.18
Anna	3.21	Fort Clark	3.31	Monahans	0.00
Austin	2.10	Fort Ringgold	0.54	New Braunfels	1.02
Ballinger	2.24	Fredericksburg	0.80	Palestine	9.68
Beaumont	3.34	Fruitland	0.72	Panter	8.36
Beeville	1.01	Gainsville	3.59	Paris	0.32
Blanco	1.00	Galveston	3.38	Point Isabel	0.00
Boerne	2.38	Georgetown	5.66	Roby	1.10
Brazoria	6.68	Grapevine	5.64	Rock Island	10.64
Brenham	21.46	Hale Center	T.	Rock Springs	0.00
Brighton	0.42	Hallettsville	12.91	Runge	2.32
Brownwood	1.64	Henrietta	0.38	Sabine Pass	0.44
Burnet	2.70	Hewitt	15.70	San Antonio	1.46
Camp Eagle Pass	3.50	Hondo	1.80	Sanderson	0.00
Coleman	2.48	Honeygrove	0.64	San Marcos	2.84
Colorado	1.54	Houston	7.02	Sherman	1.62
Columbia	10.46	Hulen	2.80	Sugarland	10.50
Conroe	7.95	Huntsville	8.56	Temple	12.42
Corpus Christi	0.92	Jacksonville	4.94	Texarkana	1.43
Corsicana	6.10	Jasper	1.02	Tyler	4.10
Cuero	13.80	Junction	0.96	Victoria	5.27
Dallas	3.58	Kent	0.89	Waco	7.30
Danevang	13.12	Kerrville	0.68	Waxahachie	7.04
Dublin	6.54	Lampasas	6.32	Weatherford	5.86
Duval	6.64	Llano	1.02	Wichita Falls	1.43
El Paso	0.34	Longview	1.98		

The geographical distribution of rainfall in Texas during this flood is shown on fig. 1, which has been drawn to represent the rainfall as given in the accompanying table.

Nearly a half century had passed since a flood of such proportions has occurred in the Brazos River, and it has been fourteen years since there has been an overflow of any consequence. The planters had constructed tenant houses on the low lands,

and owners of small farms had built their homes without considering the possibilities of such a flood. The productiveness of the soil had caused the agriculturists to approach nearer the banks of the river each year until the greater portion of this valley had reached a high state of cultivation. Hence the damage from this flood to agricultural interests was very great. All crops on the first bottoms of the Brazos and several of its tributaries from McLennan County south were totally destroyed, and in places the crops on second bottoms were badly damaged. Cotton planters suffered most; a large amount of corn was destroyed, and much sugar cane was lost. The loss to truck growers was very heavy. Farming implements, stock, and many of the small houses in the bottoms were washed away. The number of lives lost was between 30 and 35. Some of those reported drowned at first have since been found alive. This is said to be the first loss of life from overflows of the Brazos River.

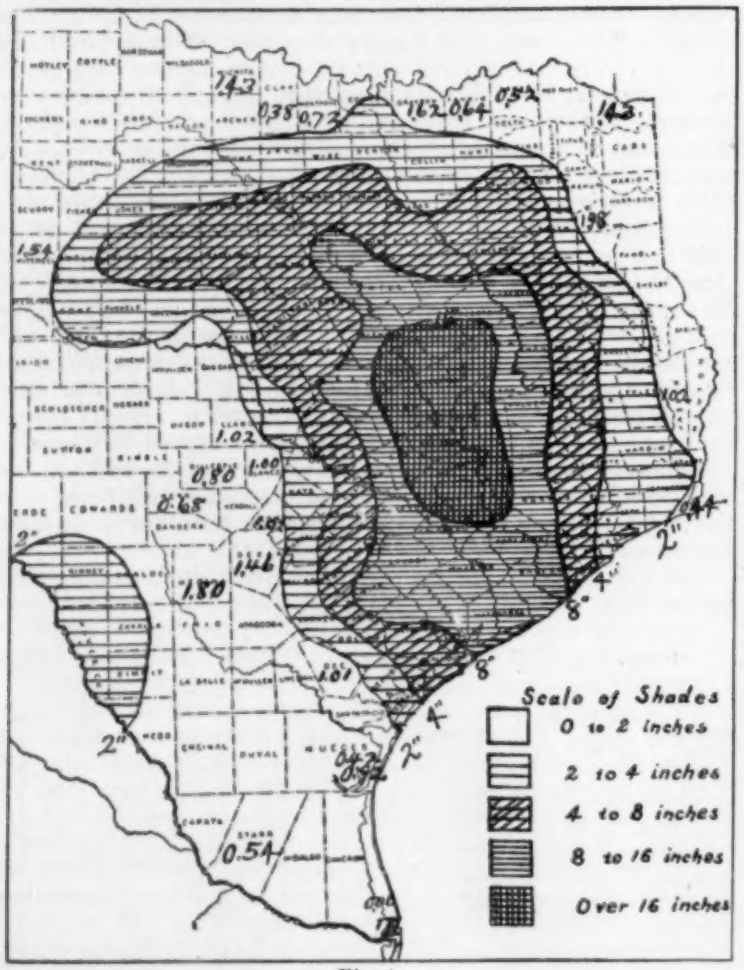


Fig. 1.

From the best available sources a conservative estimate has been made of the losses to agricultural and kindred interests by counties is as follows: Limestone, $10,000; McLennan, $10,000; Bell, $46,200; Falls, $345,000; Milam, $1,000,000; Robertson, $320,000; Burleson, $716,000; Brazos, $350,000; Washington, $1,036,656; Grimes, 275,000; Austin, $450,000; Waller, $480,000; Fort Bend, $2,500,000; and Brazoria, $152,000. There were small areas flooded in other counties, but the water did not remain over the crops long enough to seriously injure them.

The aggregate loss to individuals, plantations, municipalities, and counties is, according to these estimates, $7,690,856. The loss to railroads is conservatively estimated at $1,000,000, which makes the total loss as a result of the overflow, $8,690,856.

The extent of the flooded area is shown on fig. 2. The information upon which this chart is based was carefully and systematically collected, and it is believed that it represents the actual flooded area as nearly as can possibly be shown. On receipt of instructions to prepare this report, rough charts of the counties in which the flood occurred, on a large scale, were sent to each postmaster and crop correspondent in the flooded district requesting each to show the width of the river, when at its highest, in his locality according to the scale. On receipt of the individual charts they were all redrawn on one chart. The width of the flood along the Brazos varied from about two miles in McLennan County to 25 miles near the mouth of the river. There are some small elevated places along the river which were not covered with water, but which could not well be shown through the shading.

THE PREVIOUS FLOODS OF THE BRAZOS.

The occurrence of this flood has called up references to previous extensive floods along the Brazos. The first in 1822, the next in 1833, another in 1843, one in 1852, and one in 1885. Since there is no written history of these floods, it appears that the publication of reliable information concerning them, along with the report of the flood of this year, will be of interest and value as part of the history of the weather in Texas. All available information should be published so as to preserve it. It is difficult to obtain information regarding the earlier floods, as files of newspapers published at the time of their occurrence, and which might have contained some account of their extent, have been destroyed by fire. All floods previous to this year have been earlier in the season, as a rule, in May.

On May 26, 27, 28, and 29, 1885, heavy rains fell over the central and northern portions of the Brazos drainage basin. The heaviest rainfall reported, 8.38 inches, was at Hewett, in McLennan County. Floods were reported from McLennan, Bosque, Falls, and Robertson counties, May 29, 1885. In Falls County the Brazos was five miles out of its banks, and all the bottom lands in the county were inundated. The loss at Waco on May 29, 1885, was placed at $103,000. The crest of the flood reached the vicinity of Hearne, May 31; between the main Brazos and Little Brazos everything was submerged, and water was higher than since 1852. The crest of the flood reached Austin County June 4, 1885, and reached Columbia, in Brazoria County, June 12. The water was within four inches of the highest water of 1852 at Columbia. North of Brazoria County the overflow of 1885 was not as high as that of 1899 by four to six feet.

The overflow of 1852 commenced during the latter part of February, and its crest reached the Gulf of Mexico about March 5. I can find no reference to the extent of this flood north of Brazos County. The overflow being early in the season no material damage resulted to crops, hence it received very little attention. The high water mark of 1852 is 2 to 3 feet below that of 1899, at Allen Farm, Brazos County.

The overflow of 1843 occurred during the month of May, but I have been unable to locate the exact dates of its occurrence. The stage of the river during its overflow was about twenty inches higher than in 1852, but was not as high as that of 1899 by about five feet in the vicinity of Duke, Fort Bend County.

The flood of 1833 was highest in the vicinity of Duke, Fort Bend County May 1, where the high water mark is three inches below that of 1899. This overflow commenced during the latter part of April and passed into the Gulf of Mexico early in May.

Very little is known of the flood of 1822, except that it was

FIG. 2.

Brazos Drainage Basin

FROM WACO SOUTH

DRAWN UNDER THE SUPERVISION OF
I. M. CLINE, Local Forecast Official,
by
W. T. LATHROP, Observer

SCALE OF MILES

FLOODED AREA SHOWN THUS:

the greatest that had occurred for several years prior to that time.

The following extract from a letter, dated Navasota, Tex., August 18, 1899, from Hon. Rufus Grimes, who has resided in Grimes County in the neighborhood of seventy years, is an interesting bit of flood history pertaining to the Brazos River:

In regard to the overflows of the Brazos River, my information comes from several men who had been repeatedly through portions of Texas previous to the introduction by S. F. Austin of his 300 families as colonists. These men told my father when I was a small boy (Mr. Grimes was born in 1819), and told me after I had attained the age of maturity, that the Brazos River had not been out of its banks for over thirty years until 1822, when there was a great overflow. The next overflow was in 1833, which came in May of that year; this overflow was considered by the early settlers the greatest overflow that had ever been known by white people in the streams west of the Mississippi River. I passed over the prairie where the present City of Navasota now stands in May, 1833, and the back water was 2 to 4 feet deep all over the prairie. I can not state positively the difference between the overflow of 1833 and that of the present year (1899), but I think the water was several feet higher at this place in 1833 than in 1899. The 1833 overflow did very little damage, as there was not exceeding 100 acres in cultivation in the present Grimes County portion of the Brazos bottom, and there was no stock in the bottoms.

The next overflow was in 1843. Perhaps the greatest damage done by this overflow was the destruction of a grist and flour mill on Beason's Creek near the present town of Courtney, constructed to run by water power.

I do not remember anything of the overflow of 1852.

* * * * * * *

The overflow of 1899 has been by far the most destructive of any that we have ever had, for the reason that in recent years there has been a mania among farmers for bottom lands, and nearly all the bottom lands are in cultivation. While I do not think that any overflow since 1833 has been as high as that by 5 or 6 feet, the present flood has destroyed crops, stock, and other valuables amounting to perhaps two or three times the value of that destroyed by all preceding overflows combined in Grimes County.

* * * * * * *

I have never known of any loss of life from overflows on the Brazos until the flood of 1899.

Mr. John R. Fenn, Duke, Tex., has had a cattle ranch in the Brazos bottoms for many years and has noted the high water marks of the several floods. In a letter dated Duke, Tex., August 19, 1899, Mr. Fenn gives valuable information regarding overflows, as follows:

Both in 1833 and 1843 the creeks and lakes in this locality were dry; in fact there was no water in the county whatever, and all waters of the two floods were brought down by the rivers from up the country, while in 1899 every creek and slough was filled to its utmost by the heavy rains prior to the overflow; such being the case there could not have been any more river water brought down the stream in 1899 than in 1833. The flood of 1899 is the only overflow that has hurt the farmers of this section of Texas. All previous floods came before planting time, or sufficiently early to enable farmers to replant their crops. The overflow of 1852 was 18 or 20 inches below the highest water mark of 1843.

Efforts are being made to obtain reliable information from other points along the Brazos regarding the early floods, and if anything of interest is secured the same will be submitted for publication as a supplement to this report. I wish to acknowledge valuable assistance from Col. John D. Rogers, of Galveston, for references in connection with the early floods of the Brazos.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of the Central Meteorologico-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the *Boletin Mensual*. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for July, 1899.

Stations.	Altitude.	Mean barometer.	Temperature. Max.	Min.	Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Cloud.
	Feet.	*Inch.*	° *F.*	° *F.*	° *F.*	%	*Inch.*		
Colima	1,600	.....	91.4	68.0	.....	.....	.....	.....	.....
Culiacán Rosales (E. d. S.)	112	29.71	97.5	73.4	85.1	67	9.00	ne.	.....
Durango (Seminario)	6,243	24.06	107.6	55.4	69.4	65	4.08	sw.	se.
Leon (Guanajuato)	5,934	24.33	86.7	52.7	68.9	68	5.70	se.	se.
Mexico (Obs. Cent.)	7,472	23.07	78.3	50.9	62.1	68	3.33	n.	ne.
Morelia (Seminario)	6,401	23.98	77.0	53.6	64.0	80	7.85	e.	e.
Oaxaca	5,164	25.10	95.0	52.7	68.2	78	5.46	nw.	ne.
Puebla (Col. Cat.)	7,112	23.37	78.6	51.1	65.7	80	8.40	ese.	ese.
Saltillo (Col. S. Juan)	5,399	24.82	88.3	61.7	73.2	64	1.30	nnw.	se.
San Isidro (Hac. de Guanajuato)	.....	.....	77.4	66.2	.....	.....	7.83	se.	.....
Silao	6,063	24.30	80.1	59.7	70.0	.....	7.91	ese.	ese.
Tuxpan	19	30.13	104.9	69.8	84.0	79	3.69	e.	e., s.
Zapotlan (Seminario)	5,078	25.20	85.1	57.2	69.8	66	6.23	n.	s., e.

VOLCANIC ERUPTIONS IN HAWAII.

By CURTIS J. LYONS (dated July 29, 1899).

In reference to my note "Sun spots and Hawaiian eruptions," in the MONTHLY WEATHER REVIEW for April, page 144, the Editor remarks that only one side of the question is presented.

The distinction which I make between crater activities and actual flows of lava was not, I perceive, sufficiently emphasized in that article. It was the intention to do that by the heading of the second column, viz, "Most important lava flows or eruptions."

The flow of 1877 should have been added to the list as belonging to the minimum sun spot period of 1878. This leaves only the brief and unimportant flow of 1851, which might be regarded as only preliminary to 1852, so that very little indeed can be said on the other side if the distinction above made is observed.

The newspapers, of course, make the most of every source of excitement and count brilliant activities in both Kilauea and Mauna Loa in the same category with flows of lava. The latter change the topography of the island and, moreover, cause what is termed "volcano weather," and are preceded and accompanied by vast volumes of smoke, not steam.

This smoke rises to a height which I carefully estimated on a previous occasion (in 1877) to be 16,000 feet above the summit of the mountain, making 30,000 feet above sea level, and then floats off to the northeast, carried in a horizontal direction by the upper current. On this occasion it appears to have sunk to the level of the sea about 600 miles from Hawaii and was then brought back by the trade wind, covering the entire group with heavy smoke from the 18th to the 20th, fourteen days after the eruption. The steamer *Mariposa*, coming from San Francisco, met the smoke cloud at the above distance from Honolulu. At first the smoke was overhead, then as the steamer proceeded it covered everything at sea level. Meanwhile the disturbance caused by the local heat on Hawaii had interrupted the trades to leeward, and a surface southerly current brought the light lower smoke to Honolulu on the 12th of July.

The editor's reference to "only one side of the question" was intended to suggest that in investigating the connection between two remote subjects, such as solar sun spots and Hawaiian eruptions, it is necessary to consider, not only the agreements of the facts with any given hypothesis, but also the cases of disagreement, and it is not clear that the latter has been properly done in the present case. We have not at hand a complete list of the eruptions of lava from Mauna

Loa, Kilauea, and Hualaloi, (which are, we believe, the only three active craters in the island of Hawaii, and, for that matter, in the whole of the Sandwich Islands), but the date 1851 is given in the Encyclopedia Britannica in addition to those given in Mr. Lyons' two articles, and there are discrepancies enough between the exact dates of eruptions and the sun spots to make one wonder how there can be any causal connection between the two. In some cases the eruptions appear to precede the sunspots, in other cases they follow. In one case the eruptions between 1851 and 1859 seem to have favored the maximum sun spots quite as much as the minimum.—ED.

OBSERVATIONS AT RIVAS, NICARAGUA.

The records contributed for many years by Dr. Earl Flint, at Rivas, Nicaragua, include barometric readings. His present station is at 11° 26′ N., 85° 47′ W. The observations at 7:17 a. m., local time, are simultaneous with Greenwich 1 p. m. The altitude of this barometer is now said to be 4 feet above ground; the thermometer 6 feet above ground; the rain gage 7 feet above ground. The ground is 210 feet above sea level. Until the barometer has been compared with a standard it seems hardly necessary to publish the daily readings. The wind force is recorded on the Beaufort scale, 0–12. When cloudiness is less than $\frac{1}{10}$, the letter "F," or "Few," is recorded.

This station is situated on the western shore of Lake Nicaragua, not far from the eastern end of the western division of the Nicaragua Canal. The volcano Ometepe, on an island in Lake Nicaragua, is about 10 miles northeast of the station. Dr. Flint's records occasionally mention the presence of clouds on the summit of this mountain.

Dr. Flint's reports to the Weather Bureau now embrace two distinct features, namely, the simultaneous morning observations and the daily climatological summary, as given in the two following tables for each month.

Simultaneous observations at 1 p. m. Greenwich (or 7:17 a. m. local) time, July, 1899.

Date.	Temperature.		Wind.		Upper clouds.			Lower Clouds.		
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.
	°	°								
1	79	72	ne.	5	cs.	2	sw.	k.	2	ne.
2	78	74	ne.	6	.....	.....	.....	kn.	10	ne.
3	76	73	ne.	5	.....	.....	.....	ak.,k.	1,9	ne.
4	77	75	ne.	6	.....	.....	.....	k.	8	ne.
5	78	71	ne.	7	ck.	10	se.	.....	.....	.....
6	80	73	ne.	5	ck.	10	sw.	k.	Few	ne.
7	80	73	ne.	6	ck.	8	sw.	ak.	2	ne.
8	80	72	ne.	7	.....	.....	.....	ak.	4	ne.
9	80	73	ne.	5	.....	.....	.....	k.	10	ne.
0	80	73	ne.	5	cs.,ck.	9	sw.	k.	1	ne.
1	80	73	ne.	5	ck.	10	sw.	k.	Few	ne.
12	76	73	n.	0	.....	.....	.....	ak.	10	n.
13	78	74	ne.	3	.....	.....	.....	ak.,k.	9	ne.
14	77.5	73	ne.	0	.....	.....	.....	f.k.	10	ne.
15	78	73	ne.	3	.....	.....	.....	k.	10	ne.
16	79	75	ne.	5	.....	.....	.....	f.k.	10	ne.
17	81	77	ne.	6	ck.	5	sw.	f.k.	1	ne.
18	81	74	ne.	6	.....	.....	.....	f.k.	9	ne.
19	76	73	ne.	6	.....	.....	.....	kn.	10	ne.
20	79	75	ne.	3	.....	.....	.....	f.k.	9	ne.
21	73	73	n.	0	.....	.....	.....	kn.	10	n.
22	77	73	ne.	5	ck.	8	sw.	f.k.	1	ne.
23	78.5	73	n.	5	ck., c.	10	sw.	k.	Few	ne.
24	77	73	ne.	3	.....	.....	.....	f.k.	10	ne.
25	78	75	ne.	2	.....	.....	.....	f.k.	10	ne.
26	77	74	se.	3	.....	.....	.....	k.	10	se.
27	75.5	73	ne.	0	.....	.....	.....	ak.,k.	9	ne.
28	77	74	ne.	3	.....	.....	.....	ak.,f.k.	8	ne.
29	79	75	ne.	4	.....	.....	.....	ks.,k.	1	ne.
30	79	75	ne.	5	ck.	6	sw.	k.*	Few	ne.
31	77.5	74	se.	3	.....	.....	.....	k.	8	se.
Means	78.2	.....	.....	.....	.....	....	.....	.....	.....	.....
Departure	+1.3	.....	.....	.....	.....	.....	.....	.....	.....	.....

*On Ometepe.

Climatological observations for twenty-four hours ending at 7:17 a. m. local (or 1 p. m. Greenwich) time, July, 1899.

Date.	Temperature.		Wind.		Average cloudiness.	Total rainfall.
	Maximum.	Minimum.	Prevailing direction.	Maximum force.		
	°	°				*Inches.*
1	84	76	ne.	4	8	*0.00
2	84.2	78	ne.	6	7	0.00
3	84	77	ne., se.	6	10	0.93
4	84.5	75	ne.	5	9	0.08
5	86.5	78	ne.	6	6	0.00
6	89	77	ne.	7	10	0.00
7	86.5	78	ne.	6	9	0.00
8	89	78.5	ne.	6	4	0.00
9	87	79	ne.	7	6	0.04
10	89	79	ne.	5	7	0.00
11	88	78.5	ne.	5	8	T.
12	87	79	ne.	5	9	0.11
13	83	75	ne.	4	9	T.
14	87	77	ne.	4	8	0.16
15	87	76.5	ne.	4	9	0.20
16	84	77	ne., se.	4	10	0.70
17	84.2	77	ne.	5	9	0.00
18	88.6	77	ne.	6	2	0.00
19	86	79	ne.	7	7	T.
20	87	75	ne.	6	5	0.20
21	87	78	ne.	4	9	2.09
22	83	75	n., ne.	5	10	2.32
23	84.5	76	ne.	6	5	0.00
24	86	77	ne.	7	9	0.40
25	83	77	ne.	6	10	0.83
26	83	77	ne.	5	8	1.80
27	77.2	75	ne., se.	5	10	0.71
28	83	75	ne., se.	3	7	0.00
29	85	76	ne.	5	4	0.00
30	88	77	ne.	5	5	0.10
31	87	78	ne., e.	5	7	0.02
Sums	.....	.....	.....	.....	.....	10.69
Departure	.....	.....	.....	.....	.....	+3.93

*The rainfall at 3 p. m., June 30, was reported on that date. Strictly speaking, therefore, the rainfall for June is 7.53 and that for July is 10.85, and the 0.08 measured at 1 p. m. of July 31 belongs to the record for August.

Since early in June farmers have asked me for forecasts of rain, but to all I have replied, "No rain until the northeast trades cease." On the 15th the wind veered to southeast, with sprinkles at 9 a. m., but then back to northeast. Little hope for the first corn crop. Great complaints of dryness from Costa Rica. On the 31st, although the July rains are 3.93 above normal, yet there is still complaint of dryness.

THE TORNADO AT NEW RICHMOND, WIS.

By Prof. O. G. LIBBY, Madison, Wis.

The Editor has received from Prof. O. G. Libby, instructor in history at the University, Madison, Wis., quite a full special report on the tornado of June 12, 1899, that destroyed the City of New Richmond, Wis., from which he makes the following extracts:

I observed the ruins and other phenomena for two weeks after the tornado occurred, while aiding the sufferers. Mr. Emil Gerde, of Star Prairie, Wis., stated that he saw the storm approach and watched its first destructive action. He states that the cloud had three parts, a central cone larger than the others and showing a square ragged base, with the body twisted like a rope. On either side of this was a smaller cone that swung free in and out, to and fro, licking up a building, leaping and swaying as the cloud advanced. Sometimes a considerable distance separated them, and then again they would be close together. The western cone was larger than the eastern. The cones were of a yellowish tint, like flames, especially the central one. Intense darkness preceded the storm, the noise was like that of an immense wheel turned by machinery, in which there was considerable slack, so that the sound was uneven. The sun shone out after the storm. The reports from Polk County indicate three paths of destruction, the central one being the worst of all. I crossed the central path twice in driving near Clear Lake, where the bushes were stripped of bark and old logs lying partly in the ground, had been moved for some distance. Even on a sloping hill covered with small bushes, everything was bruised and pounded flat, as though logs had been rolled or dragged over the surface.

Among the numerous details given by Mr. Libby, we select

only the following items whose numbers correspond to locations on fig. 3:

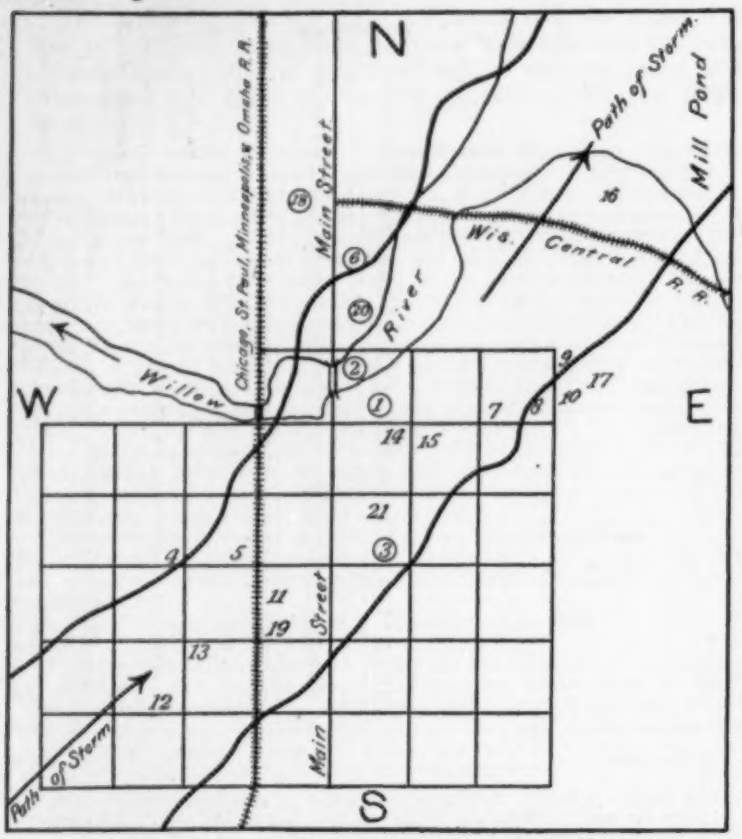


Fig. 3.—Path of destruction through the City of New Richmond, Wis.

1. Here an iron bar 4 feet long, 4 inches wide, and ¼ inch thick, was driven into a lombardy poplar and solidly embedded at about 3 feet above the ground. The bar pointed toward the northwest and was said to have come from a blacksmith's shop in that direction, on the other side of the Willow River.

3. Dr. Epley's house and office; the eastern end of the office was blown away, but the house was standing and in a fair state of preservation; this is one of the marks of the work of the eastern cone.

4. Dr. Krapps' house and office; the house was turned from the west around to the south on its foundations.

5. A complete circle of boards driven deep into the earth, the circle was 90 feet in diameter and was best marked in the northwest quadrant. Furrows showed where other boards had struck the earth and were carried on. At the same place was found the body of a boy who had been carried from Hawkins' house, No. 19.

6. A sill beam 20 feet by 10 inches, from a destroyed planing mill, 2 rods to the southeast is here thrust into the ground, so that only 5 feet protruded, pointing toward the southeast.

7 and 8. Buildings standing but the roofs gone.

13. Judge Hough's house a wreck, but walls still standing. To the west and southwest of this there was complete destruction.

14. A dwelling house, some of whose contents were carried southward.

15. The power house, whose beams were carried northward, and the library whose books were carried northward.

16. Glover's lumber yards practically untouched.

18. The point from which Emil Gerde saw the tornado cloud approaching.

The loss of life was very large in the cellars where people fled for shelter. The wind was so fierce that everything was swept clean, then the débris from other buildings poured into the cellars with fatal results.

THE USE OF THE STORAGE BATTERY FOR THE ELECTRICAL RECORDING INSTRUMENTS.

By ELISHA C. VOSE, Observer Weather Bureau (dated July 17, 1899).

The use of the storage battery, now in successful operation at the Chicago station, for the purpose of furnishing the electric current for the self-registering instruments, had been under consideration by Professor Cox for some time.

It was at first thought that the current might be taken directly from the electric light wires or the main wire, and reduced from a voltage of 110 to 4 or 6 volts by rheostat. Experiments were made along this line, the tele-thermograph being connected, but it was found that heat was being generated in the magnets; the current was at once shut off and the cause sought for, which was found to be a ground. The only way that this could be eliminated was by running a separate wire directly from the dynamo, which should not be used for other purposes. The old main feed wire which was put in to furnish the current for the experiments with the search light of the ill-fated battleship *Maine*[1] was used for this purpose. Professor Moore, while in charge of this office, had placed this light on the top of the Auditorium Tower for testing flash lights as a means of giving notice of the approach of cold waves and other warnings. But it was not practical to run a separate wire on account of the cost, and then there were other reasons why the direct current would not be feasible, even on the direct main feed wire: 1. If at any time it should be necessary to shut down the dynamo for repairs, or otherwise, the power for all the instruments would be affected, and the record would be lost for a longer or shorter period. 2. If in any way the main wire should become grounded with the building or with other wires, as was very liable to happen, it might cause the very delicate magnets to be burned out, thus destroying the effectiveness of the instruments. 3. The direct current has too high a potential, even if greatly reduced by the rheostat, to be adapted to furnish the current for such delicate mechanism as these meteorological instruments contain. For these reasons it was apparently necessary to abandon further experiments with the direct current.

Attention was then turned to the storage battery as furnishing a steady current of high intensity and low potential, such as would be especially adapted for furnishing the electromotive force for delicate instruments.

The Auditorium Association, through Mr. A. W. Sawyer, the secretary, very kindly consented to furnish the storage battery in order to give this important forecast center and station an up-to-date electrical equipment, if after a test of thirty days, it was found to do the work in a satisfactory manner.

Eight cells were purchased and these were divided into four batteries of two cells each; two of these batteries are always charging, while the other two are furnishing the current. Each of these batteries has an electro-motive force of 4 volts and a current of 12 amperes, and will run for forty hours. The current is taken directly from the electric light wires, and each battery is charged for twenty-four hours through one 8-candle power light of 110 volts, thus giving a low potential; this is also for the purpose of inserting resistance in the circuit with the storage cells from such a high voltage circuit. In order to provide against a short circuit in the electric light wires, another connection was prepared with the main wire, so that this could be used at any time in case of emergency. The batteries are connected with what is termed a "four-point switch," so that when the switch is thrown, one battery is "set in" while the other is "set out," that is, one battery furnishes the current while the other is charging. In order that there may be as little confusion as possible about the time of changing the batteries, the observer who changes the sheet at noon each day throws the switch at the same time, so that he is as little likely to forget to change the battery as to neglect to change the sheet. It will be noticed that the cells are 40 ampere-hour cells, and that they are in operation only twenty-four hours. Thus, it is so provided that in case the observer should fail to attend to the batteries at noon each day, still there would be no loss of the records on that account, as the batteries would easily furnish

[1] MONTHLY WEATHER REVIEW, Vol. XXVI, p. 58.

sufficient current for running the instruments until nearly the expiration of the 40-hour limit, or at least until the next morning. The wind direction and velocity and the telethermograph are run from one battery of two cells, and the sunshine and rain gage could also be connected with the same battery if the circuits on the new triple register were properly arranged, as this battery has sufficient electro-motive force for running all the instruments. It might be asked in case of a continued high velocity for twenty-four hours, or more, if the force of the battery would not be so exhausted as to cease to do the work. The answer would be that the electro-motive force is constant almost to the 40-hour limit, and that there is no danger of the battery not having ample force to do the work. The internal resistance is remarkably low and the construction enables the cell to be charged at a minimum electro-motive force, and to be discharged at a maximum.

The elements of the American storage cells consist of two plates made from solid sheets of pure rolled lead, grooved on both sides, separated by a rubber separator, and bound together with large rubber bands, and the "active material" is formed from the lead itself by an electro-chemical process, and is strongly adherent. The fluid consists of a mixture of one part by volume of sulphuric acid to five parts of water. As now arranged the second battery runs the sunshine recorder and rain gage, and it is also intended to put all the electric bells in the office on this battery.

The batteries have now (July 17) been in operation since May 28, and they are doing good work. The life of the battery for our light work is thought to be from five to ten years before the elements have to be renewed, and at the present price the cost for renewing the elements would be about one-half the original cost. The original cost was about $45 for the entire equipment.

IRRIGATION BY WIRE.[1]

By ARTHUR BETTS, Voluntary Observer, Weather Bureau, Ridgeway, Iowa.

(1) *June* 12, 1899.—My idea is to collect moisture from the air. Wire will do the work; it will take the moisture, which will roll down in drops, to the ground. We want poles about ten feet high. Only a few are required to the acre, and five acres in the square form would not take more than 50 poles. Put on the wire and make a complete network of wire overhead, joining from every direction, and in those countries where mountain or river irrigation is impossible man will be his own rainmaker. The wire might be painted green or blue, those being cool colors and capable of condensing more moisture. This would be a cheap means of irrigation. The idea first occurred to me a year ago.

(2) *July* 14, 1899.—Some time ago I wrote to you about collecting moisture through the medium of wires and received a reply stating that you wanted me to make some successful experiments. * * * I have the affair in running order and will report to you when I can have sufficient data. I have already made one successful experiment; but, as in the heat of summer fog and mist seem to come at long intervals apart, it may be several months yet before I can report to you on the results of my experiments. We are having much rain, followed by warm sunshine, but not much fog.

[1] Some months ago Mr. Betts informed the Chief of the Weather Bureau that he was confident that the important problem of the utilization of fog in arid regions could be best accomplished by using wire or wire screens as the obstacle to catch the fog and conduct it as drip to the roots of the plants. The Editor requested him to make actual experiments and measurements. The following three communications from him give the story of his first work and its results. Of course similar experiments in other regions are very much to be desired.—ED.

(3) *August* 22, 1899.—The following table shows what can be done with wire as a means of irrigation. The poles, four in number, are 7 feet high and cover 7 by 7 feet, equal 49 square feet, of surface, and the wire is netted in 6-inch squares. The following shows the result in fog, mist, and dew:

The wires were common fence wire. As wood absorbs too much moisture, I used a tin basin 9 inches across and 3 inches deep [to catch and measure the drip.—ED.]. It was round and the sides very nearly perpendicular. During the forty days the Government rain gage collected 3.44 inches precipitation, of which 0.13 inch was fog, mist, and dew, and this 0.13 inch was twelve times that amount by wire [? $\frac{1}{12}$ of the amount—ED.], and the wire was not painted, either. It was quite a sight to see the wire dripping with ten thousand drops in the early morning. My observations show that even dew can be utilized for irrigation purposes. My rule is to place the wire network in squares whose sides are as the square of the altitude, e. g.: At an altitude of 1 meter, 9 square inches; 2 meters, 36 square inches; 3 meters, 81 square inches; 4 meters, 144 square inches; 5 meters, 225 square inches; 6 meters, 324 square inches; 7 meters, 441 square inches; 8 meters, 576 square inches. Thus, the higher the poles the less the amount of wire needed.

As the 6-inch square appears like a speck from a distance, so a speck on the ground beneath would receive all the drops of water from that far off square. My experiments are accurate even to 0.01 inch, and now, having been very successful in this work, I give it to the world, trusting that it will prove a blessing to many.

Observations of drip at Ridgeway, Iowa.

Date and month.	Kind of precipitation.			Duration.		Precipitation.		Remarks.
	Fog.	Mist.	Dew.	Fog or mist.	Dew.	In gage.	By wire.	
1899.				*H'rs.*	*H'rs.*	*Inch.*	*Inch.*	
July 14	fog.	mist.	.....	12	.....	0.02	0.30	Mist heavy.
15	fog.	.....	.....	12	.....	T.	0.07	Fog unsteady.
17	.....	.....	dew.	.....	10	T.	0.03	Dew heavy.
18	.....	....	dew.	.....	10	0.00	0.01	Dew copious.
19	.....	.....	dew.	.....	9	T.	0.03	Dew heavy.
20	.....	.....	dew.	.....	9	0.00	0.01	Dew copious.
21	fog.	.....	dew.	2	8	0.00	0.02	Fog very light.
22	fog.	.....	dew.	4	10	T.	0.05	Fog light; dew heavy.
23	fog.	.....	dew.	3	10	T.	0.04	Fog light; dew heavy.
29	fog.	mist.	dew.	5	10	0.01	0.10	Fog unsteady.
Aug. 2	.....	.....	dew.	.. ..	10	T.	0.05	Dew very heavy.
3	fog.	mist.	.....	5	0	0.04	0.35	Mist and fog heavy.
5	.....	.....	dew.	.....	10	T.	0.03	Dew heavy.
16	.....	.....	dew.	.....	10	0.00	0.02	Dew copious.
18	.....	.....	dew.	.....	10	0.00	0.02	Dew copious.
19	.....	.....	dew.	.....	10	T.	0.04	Dew very heavy.
20	fog.	mist.	.....	7	.....	0.04	0.34	Mist heavy.
21	.....	.....	dew.	.....	12	0.01	0.09	Dew excessive.
22	.....	.....	dew.	.....	11	0.01	0.08	Dew excessive.
Sums	8	4	15	50	149	0.13	1.58	

The last line shows the sums for the nineteen dates on which there was fog, mist, or dew (on the remaining twenty-one dates, out of the total, forty, there appears to have been nothing to measure.)

We quite sympathize with the enthusiasm shown by Mr. Betts in his communications on this page, and have no doubt that his experiments will lead to others of equal or greater value. We can easily understand that every wire, or every piece of woven wire fence stretched in the free air will catch fog and dew and lead it to the ground, but we do not understand why the wire should lie horizontally instead of hanging vertically, nor do we understand the argument that requires all the drops of water from a small 6-inch square of wire near the ground and those from a 24-inch square four times farther from the ground to fall upon the same "speck beneath." It is more natural to suppose that the drip from a

large horizontal surface of wire will fall vertically upon the same horizontal surface of ground. We do not see how the moisture caught by 2 square feet of wire network 8 yards above the ground, or that caught by a single loop of wire 2 feet square can be concentrated upon an area of 3 inches square at 1 meter above the ground, or upon a single point at the ground, unless there be some arrangement like a funnel to concentrate the drip.

But apart from any question as to the accuracy of our correspondent's logic, we are inclined to believe that woven wire network, such as is used for fences, may constitute an excellent arrangement for catching fog, mist, and dew. Why can not the network be placed vertically, or nearly so, as suggested on page 466 of the MONTHLY WEATHER REVIEW for October, 1898, so that the vertical drip may be led directly into the ground or to the roots of plants by appropriate small inclined gutters.

With regard to the amount of drip caught in these experiments by Mr. Betts, we make the following calculation: He states that he caught the drip from a common fence wire netted in 6-inch squares and stretched horizontally between four poles 7 feet above the ground and covering an area of 7 by 7 feet equal 49 square feet. There were, therefore, 196 open spaces, each 6 inches square, and the total length of wire was 105 linear feet. The drip from this was caught in a tin basin, nearly cylindrical, 9 inches in diameter and 3 inches deep. During the whole forty days a depth of 1.58 inch was collected. This is equivalent to $1.58 \times 4.5 \times 4.5 \times 3.1416 = 100.5$ cubic inches. If this total amount of drip be divided by the area (49 square feet) over which it was collected, we find that it would cover this whole area to a depth of about $\frac{1}{7\frac{1}{8}}$ of an inch. On the other hand, the sum total of the water caught by Mr. Betts in his rain gage in the form of dew was 0.13 in depth. But in this case the dew in the gage must have been deposited on the area of the gage mouth itself; that is to say, the depth, 0.13 on the bottom of the gage or the basin would also have been caught over the whole of the 49 square feet, or for that matter over the whole of a large field. We should say, therefore, that the drip from the fog and mist as caught on the wire screen represents an average depth of water over the field of $\frac{1}{7\frac{1}{8}}$ of an inch, but that the dew represents one-seventh or one-eighth of an inch. Since, therefore, the dew is in this case ten times that of the drip, it is evident that in Iowa the utilization of the dew is more important to irrigation than that of the drip. On the other hand, there may well be regions where the dew is less important and the drip more important. In such cases we doubt not that a thickly set system of woven fence wire in parallel vertical frames may catch enough drip to be an important aid in the irrigation of a small portion of the ground.—ED.

CLIMATOLOGY OF THE ISTHMUS OF PANAMA.[1]

By Gen. H. L. Abbott (dated Paris July 12, 1899.)

I enclose the latest figures with respect to rainfall. The complete series for three stations is given in the following table: Gorgona, being near Gamboa, has been lately abandoned as a gaging station:

Bohio.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1898 ...	12.36	1.26	3.08	10.59	14.61	19.76	34.96	38.31	13.31	28.23	21.81	6.38	204.61
1899 ...	9.41	4.49	3.27	11.30	10.36	14.80	.....	.....	.....	.....	.....	.....	.....

Gamboa.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1898 ...	2.76	0.12	0.00	1.42	5.32	4.65	18.43	20.16	4.10	8.70	14.57	2.40	82.60
1899 ...	5.00	1.73	1.34	1.42	8.54	8.78	.....	.....	.....	....	.....	.....	.....

Gorgona (now abandoned).

1898 ...	3.42	0.20	0.00	1.38	5.04	4.37	18.50	19.88	.....	7.72	9.61	3.94	[78.0]
1899 ...	3.78	2.01	3.31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] The Editor has received the following data from General Abbott, supplementary to his article in the MONTHLY WEATHER REVIEW for May, 1899.

I add a rough plot comparing your horary barometric curve at Colon with our mean at Panama. It is certainly gratifying to find so close an accordance. The entire diurnal range is very small, only $2\frac{1}{2}$ millimeters, or .1 of an inch. The difference in epoch is partly explained by your using seventy-fifth meridian time, while we use local time. As your observations are now discontinued, I thought it worth while to reduce the eight months that have been published in the MONTHLY WEATHER REVIEW. Many years ago, I had occasion to study similar diurnal curves in the interior of the North American continent in connection with our Pacific Railroad surveys, and found wide differences at the same place, due to changes of temperature. As such changes do not exist on the Isthmus, we ought to expect harmony between different series in that region and these two sets of observations, in my judgment, confirm this expectation.

The figures and curve given by General Abbott, for the hours of local mean time in the MONTHLY WEATHER REVIEW, May, 1899, pages 201–202, from three months' observations by Royer, at Panama, may be compared with the following table now given by him, as derived from eight months of Weather Bureau observations at Colon on seventy-fifth meridian time. Panama is in longitude 79° 30′ W.; Colon is in longitude 79° 50′ west. Therefore, the time scale of the Colon record for the Weather Bureau barograph still needs a subtractive correction of nineteen minutes in order to convert it into local mean time, and a similar correction of eighteen minutes in order to convert it into a simultaneous record on Panama mean time.

The hourly record for eight months, October 18, 1898, to May 20, 1899, at Colon is given in Table IV in the successive MONTHLY WEATHER REVIEWS, in English inches. It has been converted into millimeters by General Abbot, and has given him the following average departures from monthly mean values. The reconversion into inches has been added by the Editor. The Colon record from November, 1897, to January, 1898, is copied from General Abbot's previous paper. A long record of hourly readings at these two stations is greatly desired.

Mean barometric departures.

Hour.	Colon.		Panama.		Hour.	Colon.		Panama.	
	Mm.	*Inch.*	*Mm.*	*Inch.*		*Mm.*	*Inch.*	*Mm.*	*Inch.*
Midnight .	+ 0.53	+0.021	+ 0.33	+0.013	1 p. m	— 0.06	—0.002	.....	.....
1 a. m	+ 0.19	+0.007	.....	.....	2 p. m	— 0.56	—0.022	— 0.97	— 0.038
2 a. m	— 0.10	—0.004	— 0.40	—0.016	3 p. m	— 1.04	—0.041	— 1.20	— 0.047
3 a. m	— 0.40	—0.016	— 0.53	—0.021	4 p. m	— 1.17	—0.046	— 1.17	— 0.046
4 a. m	— 0.46	—0.018	— 0.43	—0.017	5 p. m	— 1.09	—0.043	— 0.93	— 0.037
5 a. m	— 0.36	—0.014	.....	.....	6 p. m	— 0.89	—0.035	— 0.60	— 0.024
6 a. m	— 0.15	—0.006	+ 0.17	+0.007	7 p. m	— 0.55	—0.022	.....	.....
7 a. m	+ 0.22	+0.009	.....	.....	8 p. m	— 0.16	—0.006	+ 0.30	+ 0.012
8 a. m	+ 0.77	+0.030	+ 1.10	+0.043	9 p. m	+ 0.25	+0.010	+ 0.68	+ 0.025
9 a. m	+ 1.16	+0.046	+ 1.21	+0.048	10 p. m ..	+ 0.48	+0.019	+ 0.80	+ 0.032
10 a. m	+ 1.26	+0.050	+ 1.13	+0.044	11 p. m ..	+ 0.60	+0.024	+ 0.57	+ 0.023
11 a. m	+ 1.05	+0.041	.....	.....	Midnight.	+ 0.53	+0.021	+ 0.33	+ 0.013
Noon	+ 0.61	+0.024	+ 0.07	0.000					

The signs printed with the departures on page 202 are really those appropriate to the reduction of any given hourly mean to the daily mean pressure, and the word *reduction* should be substituted for *departure* in the diagram on page 201. By interchanging the plus and minus signs, departures are converted into reductions, or vice versa. The figures in the present table are departures properly so-called and *not* reductions.—ED.

TORNADO OBSERVATIONS.

By A. H. GALE, Voluntary Observer at Bassett, Rock County, Nebr., dated July 28, 1899.

Wednesday, July 5, the adjoining county of Brown was visited by a tornado at 5:20 p. m., central time. The wind during the day at this station (Bassett, latitude 42° 36′ longitude 99° 55′ west) was southwest, strong in the a. m. and light in the p. m.; humidity high. Temperature 77° at 9 a. m., 90° at 2 p. m. Visited path of storm on 7th and rode over track, interviewing persons near by who witnessed it and also suffered.

Mr. A. Brown, 5½ miles northwest of Johnstown, saw it form; was at work in his barnyard, noticed it coming across his field as a light summer whirlwind such as is noticed on any still hot day. Air at the time was calm. Mr. Brown says he was harnessing a horse at the time, and as the light whirl passed him it gently lifted the straw edges of the roof of his cow shed, but had not enough strength to lift his hat, and passed on. At this point it was devoid of any color, and was mainly noticed by the whirl it made among the grass, straw, and chaff on the ground; he watched its onward movement indifferently, and soon saw it gather a color which made it definable. He then paid close attention to it and noticed it becoming black, angry, and gyrating vigorously. chips, straws, and dirt fell into it, and were absorbed by it and a smoky veil began to envelop the whirling column as it mounted upward. At the same time a funnel began to lower itself from a turbulent low-hanging cloud of an area of about forty acres; the column and funnel soon connected and with this union the "thing" took on a terrifying aspect; up to this time he had no feeling of apprehension. When the whirl passed him he said he was aware of its passage only by its action on the ground. No color. A black cloud above, in commotion, followed the whirl on the ground, which latter was eight or ten feet in diameter. This cloud was alone, separate, and clear from a higher strata of storm clouds above. When passing his point, and as long as within his line of view, he estimated the speed as 10 miles per hour, line of path east by south. I will say here that the entire path from start to end was 18 to 19 miles, and in that distance it made a southing from a due east course of 2¾ miles, and ranged from 1 to 3 rods in width. Two and one-half miles from Mr. Brown's point it crossed a large cornfield and here it received much coloring matter. That the affair was at this time in comfortable order was demonstrated by the shock it gave the first house it struck as it left the cornfield, Mr. John Strohm's. Mr. Strohm and his family saw it as it rose along the slant of the cornfield to his house on its edge, and dove for the cellar. The destruction at this place was complete; house of heavy logs, windmill and tower, and stable, in all seven buildings, completely leveled to the ground, fences upset, broken down. Fence wire woven and interwoven with broken up lumber, straw, débris of all sorts, plastered with mud. Every fence post standing in the track formed a dam around which was massed débris of everything imaginable, the whole daubed with mud; it was a picture of desolation and ruin—dismal in the extreme.

The storm struck the plantation from the west and its main track runs to the east by north down through a "draw" in which most of the trash lodged. Evidently the spout struck the place with its front face, and was not over 30 feet wide at contact. A twinebinder machine 20 feet to south of house was undisturbed. From this place the path of the vortex or storm tube was southeast by east to the place of William Lockmiller, 2½ miles. His house, a frame with an addition, neatly and strongly constructed, on brick foundation, was slid off of underpinning 10 feet to east and 5 feet to north, the two chimneys torn off, the bricks thrown to the east, two strips of shingles with the porch roof on west side of house torn off, all the shingles on east and north side have one corner broken off as one would break off the corner of the cover of a book; the roof being painted red, the broken corners showing the white wood in contrast, gave this roof a singular appearance. The barn, 50 feet south of the house, was also slid over its underpinning square to the east, but not otherwise disturbed. It was at this house that Mrs. Lockmiller was killed. She was in the cellar under the house with the children, and becoming anxious for a boy who was in the barn, started out to call him to safety, when the blast reached the house and, shoving it from the foundation, caught her coming up the cellar steps between the sills and cellar walls, crushing her to death. Had the family remained either in the house or cellar quietly, no one would have been injured. The fan and wheel of the windmill, 40 feet to the east of the house, were carried away, the tower left undisturbed. It is evident the vortex passed close to the north side of the house, as its track through the garden closely adjoining is clearly defined, and the movement of the house and barn and the observed damage were clearly caused by the inward rush of air toward the center of the whirl; shingles on roof, mud spatters, etc., clearly show this. A similar condition and effect were noted at a school house further on near end of path. Direction of vortex path at this point east-southeast.

De Long's place, next in the path of the storm, 2½ miles north of Ainsworth, is a total ruin. The house, a strong one of hewn logs, stables, windmill, and outbuildings went to general ruin. Main part of débris at this place went to the southeast, the house appeared to have been lifted clear off site and strewn over the prairie to the southeast; part of the roof was carried due north and parts to the west; the northeast quadrant shows but little débris. Mr. De Long and family were in the cellar when the house lifted. At this place direction of path was southeast for one-half mile from the house, then its course was due east. No hail or rain fell until after passing, and then both occurred. De Long says while in the cellar the house appeared to be lifted bodily, with strong upward suction (Strohm says he did not notice any upward draft), so much so that he cautioned his wife to hold hard to the children, fearing the upward pull might draw them out of the cellar. His dog was in the house and went away with it, and after the storm passed he came back from across the fields to the westward.

Mr. Trotter's place, about four miles east of De Long's, was the next place in the path of the storm destroyed. Here the destruction was complete. Most of the débris from this house (of frame construction) was thrown to the south and east, a small portion to the north and west; a trail of dish closet furniture described a section of a circle in above direction; the full circle about 4 rods in diameter. A portion of roof landed 250 yards toward the southwest, nearly at right angles to track, and smashed into kindling. Boards, sticks, etc., scattered about pointing lengthwise and from center of disturbance. A hay-covered stable and a straw field, 300 feet east of the house, by a small pool of water, were uninjured. Vortex appeared to catch the house on northwest corner. Observers state that they saw this house rise bodily into the air, whirl about in the funnel, and explode or melt into fragments. The appearance of the ruins indicates this to have occurred.

Here the track of the vortex was from the northwest to the southeast and, after crossing the road just at hand, turned due east, crossing corn field, wheat land, and a stretch of prairie. Next, meeting a couple of empty houses, one a strong log structure, it completely destroyed them. The vortex or funnel at this place apparently left its general easterly path, made a loup to north, taking in the two buildings mentioned and scattering them to the south. Evidently only the edge of the vortex struck these buildings and threw or drew them into the whirl. At this place, and across country from Trotter's place, the track, as marked on grass and fields, was not over 16 feet in width. Here, as at the other points, I observed that most of the débris fell in the vicinity of place of destruction. Between these places there is no débris, and the path is only marked by flattened grass and occasionally turf torn up; all grass in track of vortex lays regularly in line with path of storm to the east.

From this point the storm followed a nearly southeast path, passing to the south of a schoolhouse 150 feet west of its path. This latter was of special interest in demonstrating the force of the indraw or suction of the outside air toward the vortex. The brick chimney on this house was free to the southwest, toward the whirl; the shingles on the north side of the roof were ripped up and carried over the ridgepole toward the vortex. The long axis of the house stood parallel with the storm path, and it is noticed that on the south side, facing the path, the shingles were not disturbed; otherwise this building was not damaged. A Mr. Lehu, who lives near by—just to the east, and north of the path about 40 rods—says the trees of his grove at his house while the vortex passed leaned to the ground to the south; he says a strong indraw was unmistakable. At Mr. Brown's house, 400 yards from path of storm, a heavy farm wagon was turned around and upset toward the vortex. Further on Mr. Layne noted the strong indraw or suction, and his house and barn give their testimony in support; his house lay to the south of the path, and everything about his place that was movable started for the center of the storm, passing through his wheat field, 200 feet away; his house was moved to the north 4 or 5 inches. This was the last damage done. About one mile farther on the tornado died away.

A very interesting talk was had with Mr. W. E. Jerome, living 4½ miles from Long Pine, who observed the breaking up in his pasture, after having injured 20 rods of the pasture fences. He says "the funnel came to a stand, wavered, spread out, lost color and motion, and collapsed with a fall of light rubbish and loose trash, immediately followed by sharp hail; I think the hail broke it up." He estimated the funnel to be, from earth to cloud, 500 feet in length, and the tornado cloud about 80 acres in area and "detached from the cloud stratum above, which was loaded with hail." The noise he heard was a swishing sound, and it is noticeable that Mr. Jerome is the only one conversed with who speaks of any noise. The wind was from the northwest. The rain and hail, after the tornado broke up, came from the northeast, the point the funnel was heading for when it collapsed. It approached his land from the northwest by north, swinging out to the northeast and dissolving.

John Strohm seconds the statement of Mr. Brown by saying that the whirl on the ground ran for some time and did no damage, and did not appear at all dangerous till it made connection with the downward projection from the cloud above, which latter appeared to him to be about 500 feet above ground. Conservative and cool-headed observers interviewed on this point agree, in general, with these gentlemen as to the elevation of these tornado clouds.

A careful summing up of the testimony points to the conclusion that at its beginning this twister was a very simple affair, and in character like a summer dust whirl so often noticed on a still hot day in August, and impotent for harm if it went no farther. It is only when a great condensation is going on above and clouds are forming rapidly that it can take on the features of a destructive tornado, and this brings us to the study of the union of the descending point with the ascending ground whirl. The cloud point, or down-pointing funnel, like the letter V, is black, dense, and compact, while the ascending ground whirl is, comparatively speaking, void of color. I will advance a theory that may account for this. It is not possible, under the general laws of air movement, to imagine a cone of whirling air starting from the ground, gradually mounting upward from a base of 10 feet or so, and not enlarging as its volume increases, or that between the apex of this cone and the point hanging from the cloud above there is a stratum of still or dead air. It is hard to grasp such a state of affairs as this. The belief is strong in my mind that, although not visible, this ground whirl extends upward to the tornado cloud, and is entangled in it and gets its motion from it. At the ground there is no motion of the air which would start it. The ground whirl, as noticed in this present case, had a very thin edge, 5 or 6 inches, like the tire of a cart wheel or the rim of a saucer, in short a simple ring of circling air. This ring extends up to the cloud and is colorless. It envelops the cold point hanging down from above, and which is making an effort to descend to earth down the center of the hot air shaft surrounding it. Several attempts (as in this case) are made before a satisfactory adjustment of the two forces, heat and cold, in the descending core and ascending ring is effected. Until this is done nothing remarkably violent occurs, and up to this point no especial energy is apparent. When, however, the superior energy of the descending core intermingles with the moderately moving ascending rim, and both merge into a perfect whole, then the tornado is ready for business, and proceeds at once to wipe up the earth. The quick change in color of the whole gyrating mass that then occurs is strong evidence of the value of this theory. This color partakes largely of the character of the soil that is swept upward and incorporated with the mass. Were the "spout" dependent alone on water, it would not be as densely black as it is. This present tornado changed color with the ground over which it passed. The tremendous agitation did not produce the electrical discharges one might expect, but one person observed any flash, and then but one. It was observed that the tendency of the tornado was to quickly empty itself of trash picked up, and but the very lightest material remained long afloat. The circular movement of the vortex or spout was counter clockwise, being from north to west to south to east around to north. While the circular motion was clearly established, the appearance of the débris might raise doubts, on a superficial view, but when it is remembered that what was left on the ground had received the last crack of the twister the doubt disappears. In the 18 or 19 miles traveled, the time noted from this station (Bassett) to the end, 20 to 25 miles away, was about 40 minutes, but near by observers set the time 60 minutes, which must be accepted as nearer right.

The width of path at no place exceeded 33 feet, and often it narrowed to 16.

In the matter of suction, or indraw, from the surrounding air, at times it was strongly noted, at other points hardly perceptible. At Mr. Trotter's house, for instance, persons in storm caves did not feel it; on the other hand, a man staying out of his cave a little too long, was hardly able to get to the entrance. The indraw seemed stronger far away than close to.

Up to this time this section of Nebraska has escaped visitations from these terrors, all resting in the belief we were too far west and too near the mountains. It is needless to

say that that opinion no longer prevails, and among the requirements hereafter of a well-appointed establishment will be a properly constructed storm cave.

THE FORCE OF A TORNADO.[1]

By B. F. GROAT, Instructor in Mechanics, School of Mines, University of Minnesota. Dated, Minneapolis, July 24, 1899.

About forty hours after the recent tornado of June 12, at New Richmond, Wis., the writer and Mr. Peter Christianson, also of the University of Minnesota, visited the scene of the disaster.

At Boardman, Wis., about five miles from New Richmond, on the line of the Chicago, St. Paul, and Omaha Railway, we were much interested in two railroad switch targets, the rods of which, apparently owing to the great wind pressure on the surface of the targets, had become bent at an angle which from the train carrying us by we estimated at from 30° to 40° from the vertical. We endeavored to secure these rods from the railroad company in order that we might test the tensile strength of the rods and measure the angle of bending by which we might arrive at the average wind pressure on the vanes, but before Mr. W. A. Scott, General Manager of the railroad could get word to his men, considerable time having been unavoidably lost, the rods had been straightened Mr. Scott, however, very kindly furnished us with the most important dimensions of the targets, from which we have made a calculation that we think may interest the Weather Bureau; at least we believed others would like to know that two rods of the dimensions shown on the accompanying sketch (omitted) had been bent, as we suppose, by the force of the wind.

The exposure of the switch target to the wind is shown by an accompanying sketch (omitted.) A round vertical iron rod, $1\frac{3}{8}$ inch thick, supports vertically a feather-shaped iron plate that is 30 inches long and 13 inches broad.

The following is a brief outline of what we observed and our calculation: The two targets were apparently struck nearly normal to their surfaces by the wind. We had no opportunity to make a survey of the ground, although as we passed by we saw no evidence that the targets had been struck by flying débris of any consequence, but, of course, there is a chance that this may have been the case. As we could not learn the exact value of the angle of bend, we did not think the data sufficient to warrant a test of the tensile strength of the rods, but merely assumed a probable value, and from that and the dimensions of the target, calculated the average pressure per square foot of surface of the vane necessary to bring the bending moment of the rod to the point of straining.

The center of gravity of the surface exposed to the wind is about 36 inches along the central line of the rod above the bend. The area of the target, including that portion of rod above bend, is about 343 square inches. The rod at bend is $1\frac{3}{8}$ inches in diameter.

Assuming that the rod has a tensile strength of 30,000 pounds per square inch at elastic limit, which serves approximately either for wrought iron or soft steel, it is easy to show by the ordinary rules of mechanics, that the average pressure must have been at least 90 pounds per square foot of area normal to the wind, provided our assumptions are correct. If we use for the relation between pressure and velocity the formula $P = 0.005\ V^2$, we arrive at 134 miles per hour. Of course, to bend the rods to the angle mentioned would require considerable more pressure, but probably not enough to render it improbable that the rods were bent by the unaided force of the wind, especially when it is remembered that the tensile strength may be less than assumed. See line 16 from top of page 54, "Report of Board of Engineer Officers as to the maximum span practicable for suspension bridges," published by the War Department for a similar calculation in connection with the tornado that crossed the Champ de Mars.

[1] In submitting the accompanying article, Mr. B. F. Groat desires that attention be called to the fact that there is a possibility that the switch targets mentioned by him were struck by some heavy piece of flying material and not bent by the force of the wind only. On this point, he says he could not secure absolute evidence, but, from all that could be learned, he was led to believe that the targets were bent by the unaided force of the wind. Mr. W. A. Scott, General Manager of the Chicago, St. Paul, Minneapolis, and Omaha Railway made every endeavor to secure all desired information, even ordering the targets and rods taken out and shipped to him by express, for which courtesy Mr. Groat desires to make full acknowledgement.—ED.

SUDDEN OSCILLATIONS IN LAKE LEVEL—PRESSURE WAVES.

By ALFRED J. HENRY, Chief of Division.

[Extract from Lake Chart, September, 1899.]

A so-called tidal wave swept southwestward over Chequamegon Bay on the morning of July 22, 1899. The water of the bay rose suddenly about 3 feet above the normal stage, flooding a number of docks in Ashland, Wis., at the head of the bay, and causing several mills to shut down temporarily. At 11:30 a. m., the water began to recede, and by 3 p. m. it was slightly below normal. A second rise occurred about 4 p. m., and minor oscillations were noticed until the waters assumed their normal level. The wind was from the south and the weather fair.

Sudden waves and swells in tranquil weather have been noted on the Great Lakes, and commented upon from the earliest historic times. These sudden oscillations have never been, so far as known, of sufficient amplitude to seriously injure a vessel on the open lake. They may easily, however, be the cause of considerable damage in narrow channels, and especially in harbors where the shore lines converge to a point, as in the case of Ashland, thereby greatly increasing the size and destructiveness of the wave.

In April, 1893, a somewhat similar wave swept over the southern portion of Lake Michigan, causing a rise of the water in the harbors of about 4 feet.[1] Considerable damage was done to vessels anchored in the Chicago River and ports along the southeastern shore of Lake Michigan. The question was then asked, can these waves or *seiches*, as they are sometimes called, be predicted a few hours in advance of their coming?

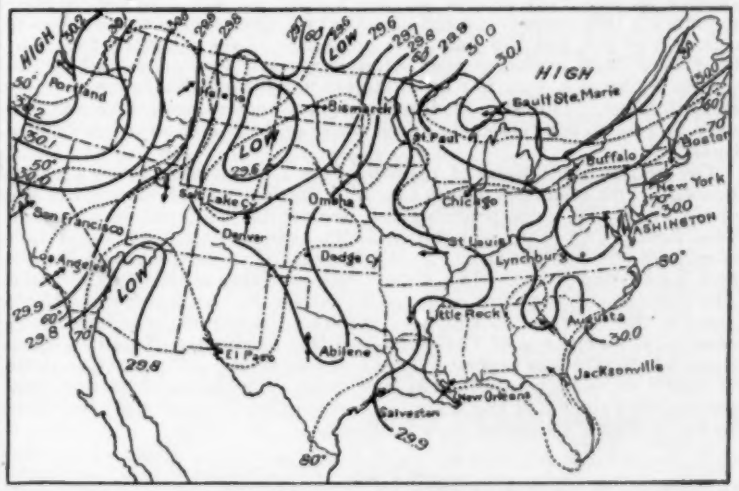


Fig. 4.—Pressure, temperature, and wind direction, 8 a. m. July 22, 1899 (75th meridian time).

The wave in Chequamegon Bay occurred at a time when the local weather conditions gave no sign of unusual disturbance. The daily weather map, however, shows that a storm whose influence extended over the region in question, was passing eastward north of the international boundary line. [See Fig. 4.] Light rain had fallen at Duluth and Port Arthur, but it is not known whether or not rain fell at Ashland.

The occurrence of sudden changes in the levels of lakes has been

[1] See Marine Record, April 13, 1893, American Meteorological Journal, October, 1893.

referred to several causes. Forel, who studied the oscillations in Lake Geneva with great assiduity, ascribes the occurrence of the seiche, a phenomenon not unlike the one under discussion, to (1) rapid local variations of atmospheric pressures; (2) the relaxation of the wind, which has heaped the lake waters up to one side; (3) a gust of wind striking the lake obliquely; (4) storms; (5) earthquakes.

* * * * * * *

Nearly thirty years ago Gen. (then major) C. B. Comstock, Engineer Corps, U. S. A., in charge of the survey of the northwestern lakes, was directed to make an examination of the seiches or unusual oscillations which occur on the lakes. General Comstock remarks on this point (Report of the Chief of Engineers, 1872, p. 1033):

"For a thorough examination of this subject, we need to have, on some one of the lakes where they occur, a sufficient number of self-registering tide gages, to record any unusual disturbance of the lake's surface which extended over any considerable area, and self-registering barometers at so many points that no local barometric disturbance could occur without being recorded. Then, if every unusual oscillation was coincident with or followed at a short interval a barometric disturbance at some part of the lake, the conclusion might be safely drawn that the latter was the cause of the former. No such thorough data exist or can be hoped for; but from an examination of unusual oscillations at Milwaukee and Marquette, it is seen that, as a rule, these oscillations occur with a low barometer, and in many cases with stormy weather, and thus suggest that the oscillations originate in barometric disturbance."

The above states the necessities of the case very clearly. Since it was written, many barographs have been installed at Weather Bureau offices in the Lake region and on vessels navigating the lakes, but, on the other hand, self-registering tide gages are lacking, except at a few places.

A number of barograph curves for the period noon of July 21 to noon of July 22, 1899, taken from instruments on vessels in harbor and on the open lake off the Apostles Islands, also at Weather Bureau stations to the westward of Duluth, are reproduced in Figs. 5 and 6. The barograph curves show a sudden and marked rise in pressure during the early morning of July 22. The amount of rise varied from about .008 to .015 inch. An increase of .015 inch in the pressure of the air would be equivalent to about 0.16 foot of water. This extra air pressure, if applied to the lake surface, as must have been the case, would tend to lower the water slightly in the region of greatest increase and to raise it in adjoining regions of lower pressure. It would also, it is believed, generate a small wave that would tend to move in all directions, but more especially toward regions of lower pressure, in the present case to the westward, since an area of high pressure covered the middle and eastern portions of the lake. A small lake wave thus generated might reasonably assume considerable proportions in approaching shoal water in a converging channel or bay. We should also suppose that the impulse of a wave so generated would be great enough to carry it to the nearest shores of the lake. In other words, an oscillation of greater or less amplitude should have been felt along the entire western shore from Ashland around by way of Duluth to, say, Port Arthur on the north. In the absence of self-registering tide gages it can not be stated whether such a wave actually occurred or not, but the fact that none was observed, except at Ashland, is of itself evidence that whatever wave was generated by the pressure changes, was not of sufficient magnitude to cause any serious damage. The size of the wave in Chequamegon Bay was due very largely to the relatively shoal water and the contour of the shore lines.

The actual oscillations of pressure over Chequamegon Bay are not known. The steamers *Zenith City* and *Merida*, whose barograms are given on Fig. 6, were probably the nearest to the point in question. The *Zenith City* was probably a little east-northeast of the larger islands of the Apostle Group in the fairway of vessels between Duluth and Keweenaw Point. The *Merida* was probably a little farther east. The increase of pressure occurred about 4 a. m., central time. If we assume that a wave in the lake resulted therefrom, it should have reached the entrance of Chequamegon Bay at about 4:45 a. m., central time, whereas it was reported by one observer as having reached there at 8:30 a. m., and by another at 10:00 a. m. The formula used in computing the velocity of the wave, as deduced by Merian[1] and simplified by Sir William Thomson, is as follows:

$$t = \frac{l}{\sqrt{(gh)}}, \text{ where}$$

t = time in minutes of a half oscillation of water, l the length of lake or other body of water, h its mean depth, and g gravity. The position of the steamer *Zenith City* was taken as 45 miles from the mouth of Chequamegon Bay and the mean depth of the lake as 240 feet. A complete vibration of the water, viz, from the steamer to the shore line east of Ashland and back to the starting point, would, according to the above formula, have occupied one hour and thirty minutes. We should note, however, that the pressure of the atmosphere did not remain stationary after the rise referred to, but rose and fell in a series of smaller undulations, and we must suppose that each pressure change was reproduced as a minute wave on the lake. We would have, therefore, not only the original wave, but a series of smaller waves, due to subsequent pressure changes, and a second series, moving in an opposite direction, due to reflection from the shore lines. While we think the high water in Chequamegon Bay was in some way connected with the pressure oscillations above referred to, there seems to be a considerable discrepancy between the time of the oscillations and the rise of the water. It is true the rate of propagation of a wave through the various channels of the Apostle Group would be less than on the open lake, but the retardation due to the islands would scarcely explain the discrepancy in time.

[1] Archives des Sciences Physiques et Naturales, Geneva, 1876, Vol. LVII, p. 278.

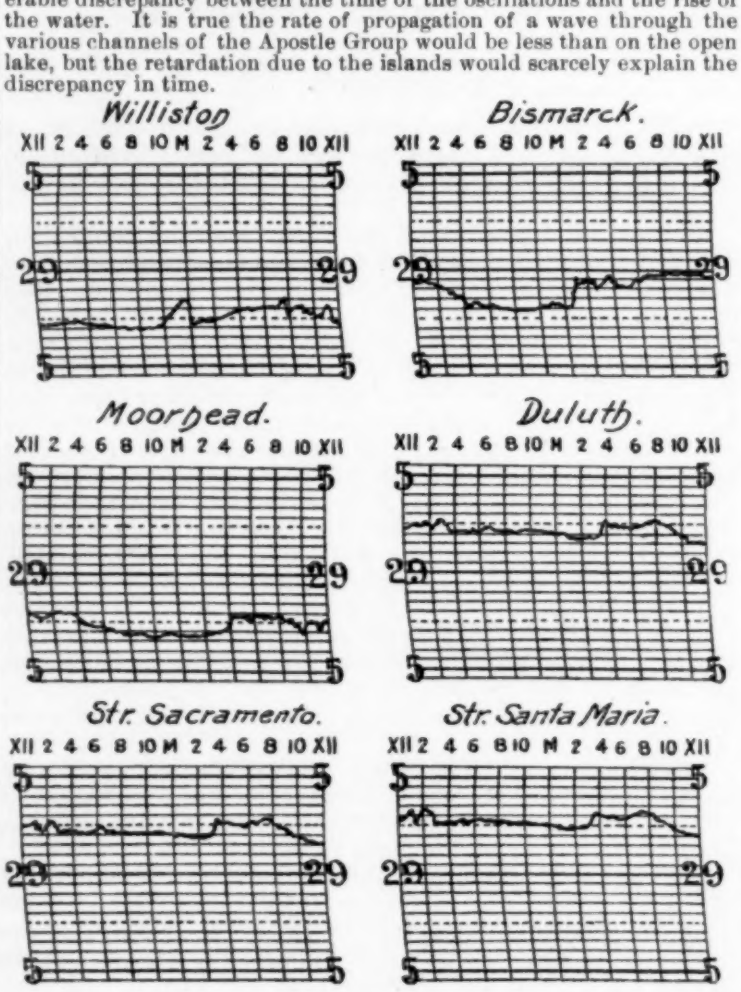


Fig. 5.—Barograms, noon July 21 to noon July 22, 1899.

The following letter from Maj. Clinton B. Sears, Corps of Engineers, U. S. A., is of particular interest in this connection:

"UNITED STATES ENGINEER OFFICE,
"519 PROVIDENCE BUILDING,
"*Duluth, Minn., August* 21, 1899.

"TO THE CHIEF OF THE UNITED STATES WEATHER BUREAU,
"DEPARTMENT OF AGRICULTURE,
"*Washington, D. C.*

"SIR: Replying to your letter of the 17th in the matter of the unusual perturbations of the water surface at Marquette, Mich. [on July 22, 1899], etc., I would say, that all the records this office has are the gage observations of that day. The gage readings are, as follows: 9 a. m., +1.62; 1:00 p. m., +1.20, and at 5:00 p. m., +1.50. The mean for the three observations was +1.44, which also happens to be the mean for the whole month.

"I would say in this connection, that it is not unusual for the water to rise and fall, in half an hour, as much as 18 to 20 inches in Chequamegon Bay and many other places on Lake Superior. Frequent and sudden rises and falls also occur in Marquette Harbor, and in many other landlocked bays and harbors they have been observed.

"Very respectfully,
(Signed) "CLINTON B. SEARS,
"*Major, Corps of Engineers, U. S. A.*"

From the above we should infer that there was considerable ebb and flow in the waters of the lake on the day in question. Pressure rose steadily at Marquette until about 9 a. m.; it fell rather abruptly .015 inch between 9:30 and 11 a. m., and remained about stationary during the remainder of the day. At Sault Ste. Marie, Mich., pressure began to fall sharply at 10:15 a. m., and continued falling until 12:30 p. m., the total fall being .012 inch.

There was a very noticeable earthquake shock in California on the date of the disturbance at Chequamegon Bay. Whether that fact shall be considered simply as a striking coincidence or whether there was any actual relation between the two phenomena, remains to be determined. We are of the opinion that a tilting of the lake bed by an earthquake shock would have produced a wave of much greater size and geographic extent than was noticed. Forel, in his study of the seiches on Lake Geneva, mentions the fact that while earthquakes frequently produce seiches, there were several sharp shocks that were not followed by seiches.

The theory that it was produced by pressure oscillations seems to be the most satisfactory, if the discrepancy in time could be accounted for. The wave of April 7, 1893, in the lower end of Lake Michigan, was accompanied or preceded by a sharp rise in pressure at several points. The barogram of the Chicago station on that date is shown on the bottom line of Fig. 6. According to Local Forecast Official H. C. Frankenfield the wave occurred between 1:30 and 1:45 a. m., April 7, which corresponds very closely with the time of the marked rise in pressure.

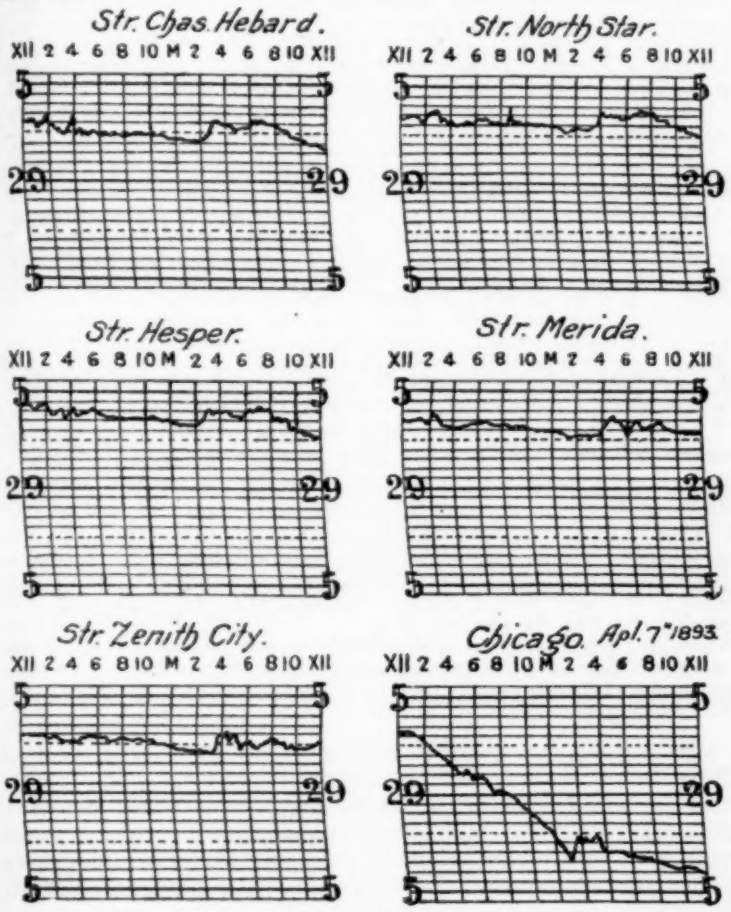


Fig. 6.—Barograms, noon July 21 to noon July 22, 1899.

NOTE.—The barograph clocks at the Weather Bureau stations in Williston and Bismarck, N. Dak., Moorhead and Duluth Minn., run on eastern standard time. Those on the vessels run on central standard time. The steamers *Sacramento*, *Santa Maria*, *Charles Hebard*, and *North Star* were in Duluth Harbor. The *Hesper* was at Superior and the *Merida* and *Zenith City* on the open lake east of the Apostle Islands.

The disturbance in atmospheric pressure on the western end of Lake Superior was local in a relative sense only. It did not extend as far east as Marquette, but, on the other hand, it was felt almost simultaneously from Duluth to the Apostle Islands, and we know not exactly how much farther in an east and west line; neither do we know its extent along a north and south line. It is a fortunate circumstance that pressure oscillations almost invariably extend over very considerable areas and shade off gradually from a maximum at some central point or axis to a minimum several hundred miles distant. There is, therefore, little danger of a large wave being created by such impulses.

It is important to note, in this connection, that the pressure oscillations on land and on vessels lying in the harbors were not so well marked as those on the two vessels in the open lake.

Looking at the results of a sudden increase of pressure from the standpoint of increased weight on the surface of the water, we are not a little surprised at the magnitude of the figures. An inch of mercury is equivalent to about 13.56 inches of water at the temperature of the water on Lake Superior. An increase in the air pressure corresponding to one-tenth of an inch of mercury would, therefore, be equivalent to an increase in the pressure on the lake surface corresponding to the weight of a layer of water 1.356 inches in depth. A cubic inch of water at a temperature of 62° F. and a pressure of 30 inches weighs 252 grains. The increase in weight over a square mile of water surface would therefore be $\frac{5{,}280 \times 5{,}280 \times 144 \times 1.356 \times 252}{7{,}000 \times 2{,}000} =$ in round numbers a little over 100,000 short tons.

TORNADO, HURRICANE, AND CYCLONE.

By HARVEY M. WATTS, Editor of the Philadelphia Press.

In pursuance of our policy of presenting matters in a popular way that may be useful to teachers in schools, we take pleasure in reprinting the following admirable article by Mr. Watts, who has long been an earnest advocate of honest fair play in the matter of meteorology and weather forecasts.—ED.

Owing to the confusion attendant upon the popular use of the words cyclone, hurricane, and tornado, as if they were interchangeable, it may be well, in these days of tornado and hurricane occurrence, to point out the radical differences between the three great classes of storm phenomena which are known to the United States. To begin with, the tornado is a purely local storm of great intensity and concentrated energy, whose main destructive effects are the result of the almost incredible velocity of its rotary winds that blow spirally into and about its vortex. Though terribly destructive to life and property, it is at the same time the smallest of local weather disturbances, being limited in duration, in the width of its path, and extent of its track. In one case it may last but a few minutes along a track a few hundred feet wide and a mile or so in length; in another it may persist for hours, its path several hundred yards in width and extending from 50 to 100 miles in length. Its forward motion on its track may vary from 15 to 30 to 60 miles an hour, but this speed is insignificant, compared with the velocity of the rotary winds which may have any speed from 100 to 500 miles an hour and over.

The rotary motion of the winds about the central core is the axis of the tornado and is usually made visible by the twisting movement of the funnel-shaped cloud, which is one of the most marked features of the typical tornado, and the actual existence of the rotary winds is made clear by the character of the destruction and the lay of the débris after the tornado has passed by. The tornado is in type nothing more than the familiar dust whirlwind common to city streets on warm or windy days, differing from it only in intensity, not in kind. Though the tornado under given conditions may form in any part of the United States east of the Rocky Mountains, it is of most frequent occurrence in the plains and rolling country of the Mississippi Valley, where topographical as well as meteorological conditions favor the formation and persistence of local whirlwinds of the tornadic type.

Aside from the destructive effects due to the rotary winds, there are in every tornado ascending currents of terrific velocity which rush up the core of the vortex, as a draught of hot air up the center of a tall chimney. As the rotary motion causes a movement of the winds away from the center of the core, the air here is so exhausted that it almost reaches the condition of a vacuum. The result of this is that in addition to the destructive effects of its rotary and ascending currents the tornado causes serious damage by reason of explosive effects, for if the center with its partial vacuum passes over a house in which the air is at ordinary atmospheric pressure, this air blows outward as if gunpowder had exploded within it. In this way some houses are destroyed which escape damage from the whirling winds.

Though not as destructive as the tornado, and hence second to it in importance in this respect in the classification of local storm phenomena, the thunderstorm is a much more extensive weather disturbance. It is not a storm disturbance rotating about a vertical axis, but moves across the country with a comparatively straight front, often many miles in extent, out from under which rushes the wind squall. In depth from front to rear the typical thunderstorm may reach from 5 to 15 miles and more. The destructive effects of a thunderstorm are due to the lightning, hail, the heavy rainfall, which sometimes approaches the character of a so-called cloudburst, and the high winds that make up the familiar outrushing thunder squall, which may occur before or after rain has begun to fall. The squall winds may reach a velocity of 60 miles an hour or so in gusts, and hence may do considerable damage, though the velocity is nothing compared with the rotary velocities of the tornadic winds.

Covering a large area, under favorable conditions, the thunderstorm may endure for hours, and in its track may cover a region from 100 to 250 miles in linear extent. Itself the result of unstable conditions of the atmosphere, it may develop within its sphere of influence secon-

dary disturbances of particularly violent type, and hence it is often the parent of tornadoes, which are small compared with the thunderstorm, while it itself is comparatively limited in comparison with greater weather disturbances that affect the circulation over extensive areas. The thunderstorm is the most extensive of local storms, and between it and the dry squalls of wind, local gusts and tornadoes, there are many variations, none of them, however, being anything but secondary disturbances, whirls and eddies in the general circulation.

The cyclone is differentiated from all local storms, whose operations are confined to a comparatively small region, since it is a weather disturbance, at its smallest, on a large scale, and at times reaches a continental magnitude. The name is of technical not popular origin, and was first used by Piddington, an English meteorologist, to describe the tempests of the Bay of Bengal and other tropical waters. It is a descriptive epithet and refers to the almost circular movement of the winds about a common center, then supposed to be the unvarying characteristic of these great and destructive storms that are called typhoons in the Eastern seas, and hurricanes in the Caribbean and West Indian waters. The word has been generalized in meteorology and is used to denote one of the two types of atmospheric eddies into which the circulation of the air in temperate zones is thrown. These are cyclonic and the anti-cyclonic.

The most destructive of all cyclones, and in fact the most destructive weather outbursts known are the tropical cyclones, the so-called typhoons of the Philippines, China Sea and Japanese waters, the hurricanes of the West Indies, and Atlantic and Gulf coasts of the United States. Though the largest tornado rarely has a diameter of a mile, the smallest of tropical cyclones rarely falls below 100 miles in diameter, and its sphere of destructive influence may range from 100 to 600, even to 1,000 miles. As the hurricane now ravaging the West Indies shows, the tropical cyclone may persist for days, traveling thousands of miles. The point of origin for the tempests that visit our coast is the eastern Atlantic in low latitudes. They cross over to the West Indies, recurve in the Gulf of Mexico, over or east of Florida, and then travel to the northeast, along the coast line of the United States, then out into the Atlantic over Newfoundland, sometimes reaching English waters. By that time they have taken on all the characteristics of a cyclone originating in the temperate zone. The destructive effects of the cyclone are the result of the winds that blow in spirally about its center, which in the front of the cyclone may reach any velocity from 60 to 90 miles an hour. The low pressure of the barometer in the center of the storm and the terrific winds lift up a tremendous sea that raises the tides above the normal, and hence through disastrous floods cause great loss to life and property along the low-lying coasts, as has been the fate of the bayou region of Louisiana and the sea islands of Georgia and South Carolina on numerous occasions. The rainfall is also often excessive and destructive.

Differing from the tropical cyclones merely in degree are the continental cyclones of the temperate zone. These are the largest weather disturbances known, but are not necessarily violent. On the contrary, they often represent a mild, vague, general circulation of the winds about a common center, within which area the rainfall may be light, heavy, nearly continuous, or broken up into separate areas. These cyclones—the real cyclones of the American Continent—may have a diameter of from 500 to 1,500 miles, and even larger, thus covering an area of over 1,000,000 square miles. They persist for weeks, and, traveling from west to east, may go two-thirds of the way around the globe. Save when their vortex is contracted to about the size of that met with in tropical cyclones, 50 to 100 miles or so, the continental cyclones are beneficent rather than destructive factors in the general circulation. When such contraction occurs in the fall, winter, or spring over the region of the Great Lakes, or over the Atlantic, the conditions repeat all the phenomena of a coast hurricane, and may cause loss of life and damage to property by reason of the hurricane velocity of the winds, the excessive rainfall, and the heavy weather on the lakes or at sea. From this it must be clear that the confusion of general cyclonic with local storm or tornado conditions, so common in the West is easily avoidable, as the contrasts are marked and the distinctions based on broad differences. The mere fact that a storm is local, of limited extent, no matter how great its violence, is the first proof that it is not a cyclone, though the tendency in the West and South is to apply the technical term "cyclone" to all violent local outbursts, on the mistaken idea that the word "cyclone" means a tornado and a tornado only. Compared with the tremendous size and appalling character of the Porto Rico hurricane and other tropical cyclones of like destructive effects, such as that of St. Vincent and Barbados last year, the tornado at New Richmond, Wis., was of small account and thunderstorm casualties trivial.

NOTES BY THE EDITOR.

EFFECT OF WIND ON CATCH OF RAINFALL.

From a recent article by Mr. Barwick, published in the Sacramento Record Union, it appears that on the average of many years the rain gages in the city of Sacramento show systematic differences.

The Weather Bureau gage was 57 feet above ground during the first part of the record, but 100 feet above during the latter part. It gives a total annual rainfall of 20.30 inches, on the average for twenty-one years.

The railroad gage at the railroad shops, 56 feet above ground, gave a total annual rainfall of 17.02 inches, on the average for thirty years.

S. H. Gerrish's gage at his residence, near the ground, gives 20.83 inches, on the average for twenty-two years.

The respective months differ among themselves very much in the same proportion in all these records.

The railroad gage is located about a mile north of the Weather Bureau, but Mr. Gerrish's gage is about a mile and a half northeast from the Weather Bureau.

Mr. Barwick says:

> There is no doubt in my mind but that the greater part of this difference in the railroad gage is due to the shop buildings, which are all mostly constructed of iron and roofed over with the same material. Then the heat from the many engines in, around, and passing through the railroad grounds causes much greater evaporation than takes place at the point of location of other gages mentioned. Then, again, the readings are taken but once a day, and if the rain ceases for several hours before measurements are made, there must be an appreciable evaporation. The railroad gage being near the south end of the building, the wind on reaching the gage passes over it at a greater velocity than were it located in the center of the roof, and as our storms are with southerly winds, it places the railroad gage to the windward of its position as to the building's location.
>
> C. C. Bonte has suggested placing the gage on a pole in the grass plot near the passenger depot, which would take it from a most undesirable location, and place it in one of the best that could be suggested in that locality, being surrounded by grass all the time, which being irrigated in summer, would reduce the evaporation to a much smaller amount than at its present location. The railroad gage and the Weather Bureau gage being of nearly the same elevation during sixteen years, should not show such a great difference as they do, and the effect of a change in location will be looked for with considerable curiosity by those interested in rainfall records.

As the records by the railroad gage are invariably smaller throughout the year than those of either of the other gages, there is some plausibility in the suggestion by Mr. Barwick that this deficit is due to the evaporation that takes place before the rain is measured. This evaporation can be greatly diminished by a better construction of the gage, but at best, is liable to be appreciable in a very dry atmosphere. If the gage at the railroad shops were so located as to be in the lee of a tall building it would catch less by reason of the interference of the building; but this does not seem to be the case. On the contrary, the railroad gage is so placed on the roof near the south end of the building that the wind strikes it with greater velocity than at almost any other location that could have been chosen; therefore, it can not be said that the gage gives a deficit because it is sheltered by a building. The great velocity of the wind at the gage seems to have suggested to Mr. Barwick the idea that there would be also a corresponding amount of evaporation. This is a true cause for a deficit, but it is hardly sufficient to explain the total annual deficit of 3.5 inches, or 15 per cent of the 20.5 inches that ought to have been recorded annually. It would be very easy for the local observer to pour a given quantity of rain water into a gage in this locality and determine, by measurement, how much evaporates every day, and calculate what would be the average amount of evaporation between the close of any rain and the time when the daily measure-

ment is made. The average length of time that elapses is probably less than twelve hours and the greater part of this is at night time when the evaporation is relatively small, so that it ought to be easy to ascertain whether Mr. Barwick's suggested explanation is sufficient.

Mr. C. C. Bonte suggests that the gage be removed and placed in a grassy park that is irrigated through the summer, thereby reducing the evaporation to a much smaller amount than in the present situation. This suggestion is, of course, in keeping with the hypothesis that the deficit in rainfall is really caused by the evaporation of water from the gage. But there are several objections to the removal of the railroad gage to another location: (1) It has not been proved that the deficit is due to evaporation; (2) the new location will also be subject to evaporation and there may, therefore, still be a deficit. (3) Even if the new location showed no deficit due to evaporation, still other sources of error would exist and the removal will simply give us a new series of measurements in a new location without telling us positively anything about the errors of the old situation or giving us any means of correcting the past record so as to obtain something nearer the truth.

The Editor can not too strongly deprecate the idea that a gage that has been used to obtain confessedly imperfect records during the past should be removed to some new location, in the hope of obtaining better records in the future. What the climatologist needs is a correct record, kept for a long time at each station, so as to obtain both normal values and the extreme departures from the normal; this is true both of temperature, rainfall, wind, and all other meteorological elements. When an instrument has been established and its record maintained for many years, it becomes a standard for all the neighborhood, and nothing but the most imperative necessity can excuse the removal to another location. If errors due to location are suspected to exist, other gages should be established and extra records be kept for the purpose of investigating the errors of the first location, and such record should be kept up until we have the data necessary for applying an appropriate correction to the records of the first place and that location should not be deserted until a new and better location has been carefully correlated with the older one, so that the old and new series may be properly combined into normal values.

In the present case, as indeed in every other one that has thus far come under our consideration, there is a much more important matter than evaporation from within the gage to be considered, and that is the effect of the wind at the gage upon the catch of rainfall. This is a matter that has been expounded by various students of the subject for a hundred years past, although probably the first who clearly saw the full importance of the matter were Bache and Henry, in 1845, and Jevons in 1861. A memoir by the Editor, read at Washington in 1887, but first published in full in Bulletin No. 7 of the Forestry Division in the Department of Agriculture, puts the whole matter in a clear and practical way. When there is no wind and the air is full of large and small drops and fine particles of mist and spatter and, perhaps, even light flakes of snow, all settle down vertically to the ground and every rain-gage within a region of a mile or two records the same rainfall. But when a wind is blowing against the side of a gage, the larger particles falling swiftly go into it, while the lighter ones are carried off to one side. In fact, snow flakes may enter the gage and be whirled out again. Under these circumstances the total catch of the gage will depend, primarily, upon the strength of the wind, and secondly, upon the shape or configuration of the gage.

Gages have been invented in which this wind effect is a minimum and, perhaps, even inappreciable, such were those devised by Prof. Joseph Henry of the Smithsonian Institution, in 1853, and by Professor Nipher of St. Louis in 1878. These are called shielded gages. If a slight protection be built up around the gage so that the wind at the mouth of the gage has its force greatly diminished, this is called the "protected" gage, and the observations by Boernstein and by Hellmann are quite favorable to this style. But the arrangement that has long been adopted as the standard in England and Europe is the so-called "pit" gage recommended by Symons. The normal pit gage stands in an open field at the center of a slight depression of a yard or more in radius. The pit is so hollowed out and the earth is thrown up in a circular ridge on the outside of the pit in such a way that, when the gage is set up in the center, the mouth of the gage is on a level with or slightly below the rim of the pit. By this arrangement the mouth of the gage is exposed to only the gentle wind that prevails at the surface of the ground the loss due to wind is small while the spattering of rain into the gage is inappreciable.

For every foot that the mouth of a gage is elevated above the ground, in the free air, the wind becomes stronger and stronger. For lower winds this increase is very nearly in proportion to the square root of the altitude, and the wind effect on the catch of the gage increases in the same ratio, so that if a gage whose mouth is 3 feet above the mouth of the pit gage shows a deficit of 6 per cent in its rainfall, then, one that is 48 feet above will show a deficit of 24 per cent. These are not merely hypothetical figures but those that actually occur, and this ratio will hold good up to 200 feet of altitude, at least in the average rains and winds of America and Europe.

Since the protection of the mouth of the gage from the wind is the most important consideration in obtaining the true rainfall, therefore, one should experiment in this direction, viz, establish a protected gage near the old gage whose records are supposed to be deficient, and determine, after a year or two of comparative readings, what its percentage of deficiency may be for winds of different velocities.

Fortunately, although our Weather Bureau gages are almost invariably placed upon tall flat roofs, yet they are also frequently well protected against the wind effect, especially when they are placed in the middle of a roof having a good parapet wall; if gages are placed too close to the parapet they may give an erroneous record. A tall building or tower with parapet wall is an obstacle in the wind, and the rain that is carried over it is distributed irregularly on the roof. Too little falls on the windward side in the lee of the parapet; too much may fall on the leeward side close to the parapet. Nothing but actual trial and observation can decide at what points on the roof the rain catch represents the normal fall in the undisturbed atmosphere. In fact, it is desirable that several gages should be read regularly so as to determine the distribution of rainfall over the roof for each direction of the wind, and for light and heavy rains or snows. Of course the distribution of snow, as it lies on the roof immediately after a storm, shows at a glance the effect of the wind on it, and by analogy, the relative effect of the wind on the distribution of rain, excepting only that in the case of snow there is a great deal of drifting and rearrangement of the snow particles that does not occur in the case of rain, which cannot be subsequently drifted after having once fallen into the gage.

On the whole, therefore, we must urge upon those who are interested in rainfall that they do not remove their gages to better locations, but that, first of all, they establish a few gages in the neighborhood and actually determine the percentage of deficit appropriate to the location and the peculiarities of the old gage.

Mr. Symons, who has examined hundreds of rainfall stations in Great Britain, finds that many observers have erroneous

measuring apparatus, and it is to be hoped that all Weather Bureau observers will see to it that both apparatus and methods are so correct that an error of 1 per cent can not occur systematically.

A copy of the Editor's article "On the determination of the true amount of precipitation and its bearing on theories of forest influences" can be furnished to any observer who desires it.

The large differences between adjacent gages are usually due chiefly to wind effects. Two similar gages set on posts in an open field, the mouths being elevated above ground 1 or 2 and 4, 5, or 6 feet, respectively, give the data for determining approximately the correction to the lower gage, so as to get results approximately free from the wind effect.

If the altitudes are H_1 and H_2 and the corresponding catches C_1 and C_2, then the the true rainfall is approximately

$$R = C_1 + \frac{\sqrt{H_1}}{\sqrt{H_2} - \sqrt{H_1}}(c_1 - c_2) = C_1 + \frac{1}{\sqrt{\frac{H_2}{H_1}} - 1}(c_1 - c_2).$$

Example: $C_1 = 25.50$ inches for $H_1 = 2$ feet, and $C_2 = 23.00$ inches for $H_2 = 6$ feet. Then will $R = 25.50 + 1.366 \times 2.50 = 28.91$. In other words, the lower rain gage, 2 feet above the ground, catches only 88 per cent of what would be caught by a pit gage at the surface of the ground in calm weather. This corresponds to an annual rainfall in the drier portions of our country and to strong winds or small raindrops. When every individual rainfall through the year has been computed in this manner, it may be possible to arrange the deficits in the order of the observed general velocity of the wind and determine the specific influence of feeble and strong winds on small or large raindrops and on snows, and on protected gages as distinguished from those that are freely exposed to the wind.

SEISMOGRAPH STATIONS IN THE UNITED STATES.

We are informed that in 1889, Mr. A. Lawrence Rotch, the distinguished patron of meteorology, purchased and set up at the Blue Hill Observatory, a Ewing-Holden seismograph, as made in San Francisco. During the first year that the instrument was maintained in working order no records were obtained. Recently the Massachusetts Institute of Technology has built a geodetic observatory for educational purposes, in the Middlesex Fells, north of Boston, in an isolated situation, and Mr. Rotch has given his seismograph to the Institute, so that it will now be installed at the new observatory within a few months. A description of this observatory is published in the Technology Quarterly for June, 1899.

We hope that this augurs well for regular seismological work in the United States, a matter that has been much neglected, except possibly in California.

It has always been the custom for meteorological observers, especially those of the Smithsonian system, to record the occurrence of earthquakes. In 1874, the present Editor, in reorganizing and extending the field of the MONTHLY WEATHER REVIEW began the regular publication of earthquake notes, so far as observations were received, and, in 1883, at his request, a joint committee on earthquakes was organized in Washington, by cooperation with the Coast Survey and Geological Survey.

This whole subject is a branch of geo-physics, coordinate with the study of vulcanology, surface geology, meteorology, tides, etc., and is worthy of special recognition. It is to be hoped that the article on the Milne seismograph, published in the MONTHLY WEATHER REVIEW for May, will revive active interest in the subject.

At present the only stations in the United States that are known to keep seismographs of any kind in continuous operation ready for any earthquake that may occur, are the following seven: Washington, D. C., (Weather Bureau, Marvin seismoscope); Middlesex Fells, Mass., (one mile from Malden, Geodetic Observatory, Ewing-Holden seismograph); Cleveland, Ohio, (Prof. E. W. Morley, Adelbert College, Gray seismograph); Lick Observatory, Cal., (Mount Hamilton, Ewing-Holden seismograph); San Francisco, Cal. (Observatory of the Coast and Geodetic Survey, G. W. Davidson, Director, Ewing-Holden seismograph); Mare Island, Cal., (Naval Observatory, Everett Hayden, Superintendent, Ewing-Holden seismograph; latitude, 38° 05′ 55.8″ N.; longitude, 122° 16′ 19.3″ W., on the crest of a hill about 60 feet above mean low water and near the northern extremity of the island; the seismograph is set up on a pier in the transit room); Oakland, Cal., (Chabot Observatory, Professor Burchalter, Ewing-Holden seismograph).

Prof. E. C. Pickering states that a Milne seismograph has been sent by him to his observatory at Arequipa, Peru, and is probably now in operation there. There are also seismoscopes on hand at the Harvard College Observatory at Cambridge, Mass., but they are not in use owing to the proximity of the electric cars.

As the vibrations of the ground caused by the electric cars are quite superficial we hope that Professor Pickering will find a suitable location for observing the genuine earth tremors and that all these stations will kindly send regular reports to the MONTHLY WEATHER REVIEW.

BACK NUMBERS.

Mr. A. Lawrence Rotch, Director of the Blue Hill Meteorological Observatory (post office Hyde Park, Mass.), desires to obtain the following numbers of the American Meteorological Journal, viz: June, July, and August, 1884, of Vol. I; June and July, 1885, Vol. II; September, October, and December, 1886, Vol. III.

TEMPERATURES IN THE SUNSHINE.

In the June report of the Colorado section, Mr. F. H. Brandenburg gives a summary of some observations made at Denver, Colo., by Mr. A. G. Eneas, of Boston, Mass. Mr. Eneas used standard thermometers with black bulbs, placed within a so-called hot box, which was constructed of seasoned pine wood five-eighths of an inch thick. Its dimensions were 9 by 3.5 by 2 inches. The cover was made of two plates of fine crystal plate glass. The inside of the box was stained with bright green water-color paint and then coated $\frac{1}{32}$ of an inch thick with lamp black. The same apparatus had been used by Mr. Eneas in Boston before he made a series of observations for several months at Denver. The greatest difference observed at Boston between the outside air temperature and the interior hot-box temperature was 40° C., or 90° F. The similar maximum difference at Denver was 98.5° F. This excess may be largely due to the pure air of Colorado or it may be due to various nonmeteorological causes. Such observations are not to be recommended, since it is so easy to do better work.

This form of hot box is one of several methods of illustrating, not measuring, the total radiation of the sun by means of its heating effects. The best form of hot box was that invented by Pouillet, more properly called the pyrheliometer, and was filled with water, which was continually stirred, so that the total amount of heating effect could be more certainly measured by the thermometer. But such apparatus

does not give us a true measure of the amount of heat received from the sun, or of the transparency of the atmosphere, unless it be used in the proper manner. If we merely allow the temperature of any inclosed thermometer to rise to the highest point it can reach, we observe maximum temperatures that depend so entirely upon the peculiarities of the hot box itself and of the wind that happens to be blowing, that no important results can be attained.

The hot box first used by Herschel, de Saussure, and other physicists of the last century, was early in this century replaced by Sir John Herschel's form of the actinometer and, subsequently, by the so-called black-bulb thermometer, which latter was improved by inclosing it in a thin spherical glass bulb inclosing a vacuum. To Arago we owe the addition of the twin black-bulb thermometer in vacuo. For a long time, and even now by English makers, the maximum self-registering thermometer was used, but in the properly constructed system devised by Marie Davy, and now known throughout the world as the Arago-Davy actinometer, both thermometers are delicate, spherical-bulb thermometers, of high grade of accuracy. The ordinary method of using this instrument is to take a series of readings when the two thermometers are exposed side by side in the open sunshine and have attained to comparatively stationary readings. The complete theory of this instrument and the proper method of calculating the results are fully given in the third section of Prof. William Ferrel's memoir Temperature of the Atmosphere and Earth's Surface, published in 1884 as No. XIII of the Professional Papers of the Signal Service. Each of the twin thermometers in vacuo attains a stationary reading when the heat received by radiation, absorption, and conduction equals that carried away by radiation and conduction. Since the two thermometers have surfaces of different absorptive powers and, therefore, different coefficients of reflection and radiation, the sunshine effects each differently, and we can, by considering a series of observations at different hours of the day, determine at once the amount of absorption of the atmosphere and the intensity of the sunshine.

In 1883 the Editor constructed and experimented with an Arago-Davy actinometer in which the thermometers were alternately shaded and exposed. Similar apparatus was taken to Russia by Mr. Rotch for use during the total solar eclipse. The same principle is embodied in Angström's and Chwolson's forms of the pyrheliometer which are described in an article by Chwolson, pages 71–75 of Bulletin No. 11, Report of the Chicago Meteorological Congress of 1893, to which the reader is referred for further details. The Arago-Davy, or the Pouillet apparatus, when properly used, gives crude approximations, but the Chwolson method gives fairly accurate results. The works of Crova, Angström, Chwolson, and Ferrel are to be commended to those who have the requisite skill in experimentation.

DESTRUCTIVE FROST OF JUNE 30, 1899, IN OHIO.

Mr. J. Warren Smith gives in his Climate and Crop report for June some account of the interesting destructive frost on the morning of June 30, in Ohio. He says:

> The interesting features in connection with this frost are its severity so late in the season and the limited area affected. A strong wind prevailed over most of the State, but there must have been wind-breaks sufficient to produce a calm over this great level district known as the Scioto Marsh. Under the clear sky the surface of the ground and of the plants lost heat rapidly by radiation, and in turn cooled the still air in contact with them, until just at the surface of the earth the temperature fell to the freezing point. The stratum of cold air must have been very thin, as the lowest temperature recorded by our voluntary observer at Kenton was 46°. His thermometers were not over six feet above the surface of the ground. We believe that if a large number of small or a few large fires had been built in different parts of the marsh a mixing of the air would have been produced sufficient to prevent formation of frost conditions.

The frost seems to have covered Hardin County and the neighboring portions of Allen, Hancock, and Marion counties. The morning map of Friday, June 30, shows that an area of high pressure was, at 8 a. m., central 100 miles northwest of this region, and the winds at Toledo and Columbus were northerly, with a velocity of 5 or 6 miles per hour. The special frost area seems to the Editor to represent not merely a region where cool air was formed by radiation and settled quietly to the ground, nor yet simply a region where the leaves of the plants cooled by radiation because the sky was clear. We have already explained in the MONTHLY WEATHER REVIEW, Vol. XXIV, p. 14, and in our "Preparatory Studies," Report of the Chief Signal Officer, 1889, p. 34, that in the middle of an area of high pressure, masses of air that are already specially cooled are descending to the ground and spreading out horizontally, forming spots of low temperature quite analogous to the inverse phenomenon, when special masses of warm moist air rise high enough to dot the sky with clouds here and there. We are inclined to think this third consideration is important and that such a mass of cold air descended upon northwestern Ohio and spread a little outward in all directions. Similar masses were descending by day and by night throughout the central high pressure area but only a few could produce destructive frost. Any one may see a similar phenomenon on a clear, warm, summer day when, in the midst of a calm period, the dust and leaves are suddenly observed to be blowing in all directions away from a central spot, and one must perceive at once that there has been a rapid descent of a small mass of denser air (it may have been drier or it may have been cooler), which, on reaching the ground, spreads outward and carries with it the dust and leaves.

CHALK-PLATE MAPS.

Not long since we had occasion to praise the excellent appearance of the maps published by the chalk plate process in the various monthly reports of the Climate and Crop Service, among which those published for Virginia particularly deserved commendation. The maps in the various reports for the month of June, 1899, showed many excellent features. We particularly wish to commend the pleasing effect of the green base and red isotherms in the New England report. The very clear print of the corresponding map in the Wisconsin report, and that for Ohio which is almost equally impressive. The black base map with red lines or the blue base with red lines seem to be the favorites, but the golden base with black lines and the green base with red lines strike us as being harmonious combinations that are also well worthy of trial. The Editor will be glad to hear from those experienced in these matters as to the relative advantages and difficulties in connection with different colored inks and qualities of paper.

TORNADO PHENOMENA.

Low Pressure.—The tornado that passed through New Richmond, Wis., on June 12, is quite fully described in the report of that section for June by Mr. W. M. Wilson, Section Director. Its path was from the southwest to the northeast, and it destroyed nearly the whole of the business portion of the town. Illustrations of the force of the wind are abundant, especially the fact that a large iron safe weighing 3,000 pounds was caught up and carried several hundred feet (possibly it was carried by the flooring on which it stood). Everywhere was to be seen convincing proof that the sudden lowering of atmospheric pressure over a small area was often the primary cause of destruction. Of course, there is no record of the

amount of the barometric depression, but in many cases a glance at the photographs shows that the houses were burst apart by the expansion of the air within. The weakest joints gave way and the walls fell outward flat to the ground; the depression lasted but a few seconds; there was no resulting wind; light and fragile materials within the rooms were not disturbed, but the roofs were sometimes carried a little way before they rested on the ground. Evidently, the expansion could only work outward and upward. The violent wind was at some height above the ground, and had such a definite limit that the upper part of a building was destroyed while the lower part was untouched by it. The gusty streaks of wind flew over the earth in some places, but grazed it in others. Regions thus affected would represent either the little whirls outside of the main tornado, or the places where the lowest end of the main whirl temporarily rose above the house tops. An outward pressure of one pound per square inch over the whole side of a house corresponds to a barometric pressure within the house greater than that outside, by about two inches of mercury, and would disrupt these slightly built frame houses, whose beams are held in place by only a few nails and wooden pegs.

When a severe wind blows past any obstacle there is a slight increase of pressure on the windward side and a diminution on the leeward. The maximum amount of the increase is given by the formula $P - P_0 = 0.0000383 \times V^2$, where $P - P_0$ is the increase in pressure expressed in inches and V is the velocity of the wind expressed in miles per hour. Therefore, for a velocity of 100 miles per hour the rise of pressure will be 0.383 inch. On the leeward side of the obstacle the diminution of pressure depends so much upon the shape of the surface that no calculation can be made, but the depression on this side may be nearly as great as the excess of pressure on the windward side if the body has the requisite shape. But the photographs show that in many cases no such wind prevailed at the time that these houses were exploded; in fact, sometimes the explosion occurred just before the wind came, and in some cases it was not even followed by any wind. Therefore, the bursting of these houses is not due to wind blowing against or through or past them.

It seems plausible that a tornado begins with a local low pressure within a buoyant cloud in regions high above the ground. As the air flows upward into this low pressure and acquires a more or less violent rotary motion the surfaces of equal pressure descend toward the earth's surface about as figured by Ferrel in his theory of the waterspout and tornado. The tornado funnel cloud represents the core of the system of whirling ascending winds and funnel-shaped isobaric surfaces; the depression in the cloudy interior may be as much as 3, 5, or even 10 barometric inches, but outside of the funnel cloud and near it a depression of 2 inches and farther away 1 inch must exist in the clear air. Below the funnel, between its end and the ground, such depressions will cause a destructive upward wind, but not a horizontal wind, and that too for a second only, as the spout moves about irregularly in the air, sometimes descending to the surface of the ground and at other times retreating to the clouds. The space immediately about the spout or funnel is undoubtedly occupied by rapidly rotating and ascending air, but as the rotation and the funnel extends downward toward the ground, the relatively quiet air beneath can not be set into horizontal rotation so easily as it can be pushed upward into the axis of the funnel. We thus perceive how a system of whirling winds and low pressure sometimes works rapidly downward above a house so quickly that the air within the house lifts the roof up, leaving the walls standing, while the whirling funnel passes onward, and its winds are not felt severely at that spot. Again, the whirl having already reached the ground may pass near a building, temporarily diminishing the pressure on one side and allowing that to burst outward on the side toward the tornado, while only a slight wind affects the building. Finally, the winds that feed a fully developed tornado can not flow toward it in straight lines, but must themselves have smaller eddies and whirls and even funnel spouts, so that buildings at some distance from the path of greatest destruction may be injured by these subsidiary whirls.

The path of destruction of a tornado will vary in width from a few rods to a half mile (160 rods). In the central portion of this path the violent winds generally obliterate all traces of the explosive action due to the sudden approach of a barometric depression, but on the outer edges of the path less violent winds occur, and the evidences of explosion are frequently visible in the débris after the storm has passed.

It does not require any great fall of the barometer on the outside of the house in order to tear apart these wooden frame buildings; for instance, in a room 20 feet square and 10 feet high, whose outside wall is held to the central frame of the house by means of large nails 6 inches apart, we have to consider only 120 nails distributed around the 60 feet that form the four edges of the outside wall. If it requires 200 pounds to pull one of these nails out of its setting, we have a total pressure of 12,000 pounds distributed over the surface of the room, which is 200 square feet, therefore, an average of 60 pounds to the square foot, or less than 3 pounds to the square inch. Now, the ordinary barometric pressure of 15 pounds to the square inch, when the barometer is 30 inches high, is diminished by 3 pounds, and becomes 12 pounds to the square inch when the barometer falls 6 inches, or when it stands at 24 inches instead of 30. This corresponds very closely to the barometric pressure inside of a thunder cloud at 5,000 feet above the earth's surface. It is a pressure that can easily occur inside of a whirling waterspout or tornado. If the lower end of a cylindrical whirl of wind, within which such a low pressure prevails, passes over any given building in such a way that the air around the building rushes up to enter the whirl, then the air within the building can not escape fast enough through the chimneys and cracks. If the doors and windows are not opened in time the roof will rise or the weakest side burst outward. Even in ordinary storms the Editor has seen the loose trap door on the roof of his house, rise up, and thereby afford escape for the air within.

On Plates I, II, and III we reproduce three photographs illustrating the explosion of houses without the concurrence of any wind to disturb the interiors. We are indebted for these to Mr. H. J. Volker, Observer, Weather Bureau, St. Paul, Minn., who obtained them from Hass Bros., photographers, with permission to republish. Mr. Volker writes as follows:

> These photographs illustrate the fact so often emphasized by the Weather Bureau that buildings are not always blown down or wrecked from without, but are burst from within, upon release from outside atmospheric pressure. The sides or walls of all three wrecks show that they fell outward. The photographer's opinion is, that perhaps the chairs in No. 10 had been set up after the storm. He is sure the boards were nailed on the windows on the west side of No. 12, and he believes nothing was disturbed in No. 22 the bay window of which lies to the east. The views show clearly, that in the absence of a cellar, the center of a room is sometimes the safest place.

LOCAL WINDS THAT ARE NOT TORNADOES.

During the summer season very many local storms pass over all portions of this country without developing into typical tornadoes. In some cases the atmospheric conditions are such that a genuine tornado would be scarcely possible; in other cases, when the atmospheric conditions are favorable, the peculiarities on the surface of the ground may contribute to prevent the formation of the whirl and resulting fun-

nel cloud. In these cases, destructive winds, hail, rain, and lightning occur, roofs are blown off, trees are prostrated, and the newspapers record a tornado, whereas to the meteorologist it is strictly speaking only a violent gust of wind, a heavy thunderstorm, a cloudburst, a hailstorm, a straight-line wind, or derecho. There are many terms applicable to these local storms, but it is certainly not proper to call them tornadoes unless the funnel-shaped cloud is actually observed. A destructive wind is not necessarily a tornado.

In the very severe storm that passed eastward, a little north of Washington, D. C., on Wednesday, August 2, 1899, the Editor studied the movements of the atmosphere until driven to shelter by the heavy rain. There was a continuous rumble of thunder from the northern sky, not an occasional clap with its echoes, but a steady angry roar that came apparently from the center of a great disturbance 5 or 10 miles distant in the north and northeast. The cirrus and altocumulus overflow from this stormy region extended southward over the observer, but left a portion of the western and southern sky unobscured. The lower cumuli flowed rapidly from the south and southwest toward the storm center. Below these clouds were the lowest scud formed at the upper surface of the layer of cold air that flows out from the region of falling rain and hail; these were seen in the distant north and north-northwest from 1 to 3 miles away. One could see that the severity of the storm was passing far north of the observer. But suddenly an intermediate fracto-cumulus scud was to be seen moving more rapidly and in larger volume from the rainy region in the north. In the progress of these scuds southward they could be distinctly seen to mingle with the southwest current and then return with it so as to describe from a third to a complete circle before they disappeared. Similar distinct whirls among the clouds have been seen, when our thunderstorms are northwest of Washington, forming clouds such as are represented by the concentric bands, shown on Plates XI and XII of the MONTHLY WEATHER REVIEW for May, 1898. Such whirls as this on the outskirts of a region of rain and hail do not owe their origin and maintenance to the updrift of buoyant moist ascending cloudy air. This latter is the mechanical cause of the great whirl disturbance fed by southerly winds rising up over dense cold air or over rising land and condensing in big black clouds.

RAIN GAGES AT HIGH STATIONS.

In continuation of the remarks on page 257 of the MONTHLY WEATHER REVIEW for June, Mr. F. H. Newell, Chief Hydrographer of the United States Geological Survey, desires to say that if at any time there is a chance to secure rainfall observers at high altitudes, he will be glad to cooperate by furnishing the gages.

SPURIOUS TORNADO PHOTOGRAPHS.

The article on this important subject on pages 203–4 of the MONTHLY WEATHER REVIEW for May, 1899, has elicited several interesting comments. The Editor was himself to blame for inserting a paragraph that has caused the only unfavorable comment that we have heard of.

In reference to Mr. P. Connor, of Kansas City, Mo., and Mr. F. Z. Gosewisch, whose names are mentioned in the article, it should be distinctly stated that they simply forwarded these interesting photographs to the Weather Bureau, and, therefore, were not the photographic artists elsewhere referred to in the article.

One correspondent suggests that the Weather Bureau officials may be unnecessarily critical with reference to the tornado photographs. It appears that most persons are satisfied to look upon the funnel-shaped cloud as the tornado photograph, but this is not meteorology. We wish to obtain for meteorological study prints from the original negatives showing both the ground below and the clouds above in their actual connection with the funnel cloud at any given moment. We do not wish to have the photographer alter the appearance of the funnel by especially intense printing, or by substituting another foreground or touching up the surrounding clouds. Every change made by him for the purpose of beautifying or of intensifying some special feature is likely to injure the photograph for our purposes, although it may render the picture more acceptable to the general public.

We have a few genuine photographs of tornado clouds; that is to say, neither by retouching nor by special printing processes have the meteorological features been appreciably altered. We shall be glad to learn of others that are equally reliable, as it will be a serious disappointment if the measurements and calculations that are being made with reference to tornadoes turn out to be based upon unreliable photographic prints.

GENERAL FORECASTS FOR WASHINGTON, OREGON, AND IDAHO.

On the daily weather map issued at Portland, Oreg., on July 11, Mr. Pague publishes the following:

Weather synopsis and general forecast for Washington, Oregon, and Idaho.

The map this morning presents the first pure type of summer weather conditions for the year 1899. Summer and winter weather types first appeared in former years as follows:

Summer.		Winter.	
1895	April 20	1895	November 13
1896	June 13	1896	October 20
1897	April 11	1897	October 19
1898	July 7	1898	October 1
1899	July 11		

The morning map of June 12 showed an almost pure summer high. The conditions that morning lacked a few distinct characteristics, which are fully shown this morning. Summer weather really began June 12, though to-day marks the pure type. From June 12 to date there has been a succession of highs moving from the ocean on the west or southwest, becoming central along the Washington coast, but not moving, as a whole, eastward over Washington; it was only the absence of this movement that prevented the highs being classed as "summer highs." The high shown over northwestern Washington this morning was off Cape Mendocino the morning of the 7th; its movement northward has been sluggish, but it is now moving eastward on about the forty-ninth degree, north latitude, the path of the summer highs. For months temperatures below the normal have prevailed, the sunshine has been deficient in amount, and up to June 5 rains were frequent. The change to seasonable weather conditions has now taken place, and regular periods of warm and cool weather will prevail. The presence of summer weather conditions makes possible the occurrence of hot northeast winds east of the Cascades, and while such are not probable within the next several days, they may occur with the movement of the next high, which will be about Monday or Tuesday next. Sprinkles of rain from the highs west of the Cascades and showers from thunderstorms east of them are probable at intervals, and rains from these causes are all that will occur until the appearance of winter weather conditions in September or October. Summer conditions are well marked by several days of cool weather with high fog, followed by several days of cloudless weather and higher temperatures, lasting about three days, then a recurrence to cooler. Under the recurrent conditions sprinkles of rain may occur.

THE PRESENT STATUS OF METEOROLOGY.

The Quarterly Journal of the Royal Meteorological Society for April, 1899, was received during the month of July and contains two articles that will greatly interest American readers.

The last few pages of the Journal are occupied by an address delivered last February by Prof. Wm. M. Davis "On the Circulation of the Atmosphere." In this article Professor Davis endeavors to correct some errors that are sadly prevalent both in Great Britain and her colonies. Explanations that were accepted many years ago are still repeated in spite of the great advance that has taken place during the past thirty years in the views of those who are recognized as the leaders of modern theoretical meteorology. Professor Davis' address reminds us of the following remarks lately made by the Editor:

> There are those who adhere to the opinion that the observer and statistician is the one best calculated to determine the causes and the processes that lie behind his observed phenomena. There are others who think that the pure mathematician and mechanician can best deal with these problems of cause and effect. A third class holds that the experimental physicist is the highest authority. Thus it happens that meteorology has during the past century been taught by three classes of authorities, each of whom found it difficult to perceive the force of the arguments of the other side. At the present moment, England, France, Germany, and America, respectively, still have distinguished members of each of these schools busily disseminating different views of the same subject. Fortunately, however, the leading tendency is everywhere toward a proper combination of observation, experiment, and theory; and we are rapidly nearing the day when the good work done in the mechanics of the atmosphere by Ferrel, Helmholtz, Oberbeck, von Bezold, Bjerknes, Margules, James Thomson, and other mathematical writers will be fully understood and appreciated by every real student, and when the experimental work of a host of prominent physicists will also be assimilated by all. Among recent works it is those of William Ferrel that most prominently stand out as cosmopolitan. Meteorological statistics, experimental data, and mathematical mechanics were drawn upon by him at every point in his efforts to elucidate atmospheric phenomena. His work still stands at the head of all, and if in any point it is to be amended in the future, it will only be when newer observations and higher mathematical powers become available for the attack on the difficult problems of meteorology.

To the ordinary reader the report on "Government Meteorological Organizations in Various Parts of the World," an address delivered on January 18 by F. Campbell Bayard, L. L. M., President of the Royal Meteorological Society, will be esteemed as the most satisfactory, most complete and authoritative statement yet published of the condition of official meteorology throughout the world. The address proper occupies eighteen pages and the appendix, giving original details, fills thirty-five pages additional. Thirty-five different organizations are enumerated as maintained by a corresponding number of countries or colonies. Of course it is impossible here to summarize the innumerable details. Perhaps the importance of meteorological work at the present time is best expressed by the table given by President Bayard, showing the amount of money granted specifically for meteorology. In most of these cases the sums appear small as compared with that expended by the United States, but they would generally be largely increased if other countries paid in cash for telegraphy, and employed the whole time of many men in distributing maps and forecasts, answering telegrams and telephones, and otherwise devoting themselves wholly to meteorological work. The annual appropriation by the United States averages about 32 cents per square mile of territory, or 1½ cents per inhabitant. In the other countries the rates vary considerably, but in no case are they at all comparable with the vast interests that are protected and benefited.

The Royal Society has earned a debt of gratitude by collecting and publishing these sixty pages of meteorological information.

THE DIURNAL VARIATION OF THE BAROMETER.

This subject is one that has been treated most exhaustively from an observational point of view by Hann who has, in numerous papers, summed up the results of his own and other investigations. In general he concludes that the twenty-four hour or daily component of the regular barometric oscillation must be due to the direct action of the sun's heat, but that the twelve hour, or semi-diurnal term which exhibits the greatest uniformity over the whole globe must be due to some cosmic influence, whose nature has not yet been suggested or suspected.

In the presence of Hann's exhaustive monographs and this check upon his efforts to arrive inductively at some reasonable explanation of the origin of these variations, it now seems necessary to stop for a while in this course of study and investigate the subject deductively. We must follow out to their logical conclusions all the laws of mechanics and physics that we know to be at work in the atmosphere. The Editor has collected many of these and is safe in stating that there are many diurnal movements and changes going on in the atmosphere that can produce second or third terms in the harmonic development, but it is not always easy to foresee what their relative importance may be. Hann, as a meteorologist, has now brought the problem up to a stage in the inquiry where the ablest mathematical students must take hold of it, and they will, doubtless, find it worthy of their genius. We doubt not that the source of the semi-diurnal terms will be found within the atmosphere itself.

RIVER DISCHARGES IN COLORADO.

The total quantity of water discharged per second by various rivers in Colorado, together with the height of the river at the gage, is published by Mr. F. H. Brandenburg in the July report of the Colorado Section. The measurements are made by the Hydrographic Division of the United States Geological Survey. The majority of the streams maintained an unusually high average during July. The discharge of the Arkansas was 46 per cent, and that of the South Platte, 38 per cent above the normal. The discharge of the Rio Grande was 146 per cent above normal, or nearly 2½ times the normal. The importance of rain-gage stations at high points in the mountains, so as to represent the whole watershed of the rivers has already been mentioned in the MONTHLY WEATHER REVIEW by Messrs. Newell and Pressley of the United States Geological Survey.

BACK NUMBERS OF THE MONTHLY WEATHER REVIEW.

Prof. H. A. Rowland, Johns Hopkins University, desires to obtain the numbers of the MONTHLY WEATHER REVIEW for the year 1882 to complete his set.

THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

PRESSURE.

The pressure distribution for the month is graphically shown on Chart IV. As in the preceding month, the pressure was relatively high on both coasts, being lowest in the Plateau region and at the mouth of the St. Lawrence. The great high areas of both the Atlantic and Pacific, especially the latter, seem to have maintained their winter positions longer than usual. Pressure in the interior of the continent was also higher than usual. As compared with the preceding month pressure fell in the lower Lake region and generally

on the Atlantic and Pacific coasts. Pressure rose in Assiniboia, Manitoba, and generally along the eastern slopes of the Rocky Mountains, the Plains, and the upper Missouri valley.

TEMPERATURE OF THE AIR.

There were no periods of unusually high temperature. In the upper Lake region and over an irregular area extending southwestward to the Mexican boundary, temperature was slightly below normal. It was also below normal on the south Atlantic coast and Florida, and along the Pacific coast from San Diego to Tatoosh Island. Elsewhere it was generally above normal, although the excess rarely exceeded 2°. Maximum temperatures of 100° and over occurred in Georgia, South Carolina, central Texas, central Louisiana, and southern Arkansas, and from Texas northward to North Dakota and Montana. West of the Rocky Mountains maximum temperatures of 100° and over were registered in Arizona, the Colorado River Valley, southern Utah, the Great Valley of California and in the Snake River Valley in Idaho, Washington, and Oregon. Minimum temperatures of 40° and less were registered over three small areas, the first in southwestern Montana and southeastern Idaho, the second in eastern Oregon, northern Nevada, and the northwestern corner of Utah, and the third in northern New Hampshire and Vermont.

In Canada.—Professor Stupart says:

Temperature was a little above the average in British Columbia, Manitoba, and the extreme eastern portion of the Maritime Provinces, and average or a little below in all the larger remaining portion of the Dominion. The greatest amount above average, namely, 4°, was recorded at Minnedosa, and the greatest amount below average, 3°, was at Bissett, on the Ottawa.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	10	68.5	+ 0.3	+ 1.3	+ 0.2
Middle Atlantic	12	74.7	0.0	− 2.0	− 0.3
South Atlantic	10	79.6	− 0.3	− 2.1	− 0.3
Florida Peninsula	7	81.3	− 0.2	+ 0.8	+ 0.1
East Gulf	7	81.1	+ 0.1	− 5.5	− 0.8
West Gulf	7	81.9	0.0	− 6.0	− 0.9
Ohio Valley and Tennessee	12	77.4	+ 0.5	− 3.7	− 0.5
Lower Lake	8	71.5	+ 0.3	+ 1.6	+ 0.2
Upper Lake	9	66.7	− 0.6	− 5.7	− 0.8
North Dakota	7	68.9	+ 0.2	−19.0	− 2.7
Upper Mississippi	11	75.1	− 0.1	− 9.4	− 1.3
Missouri Valley	10	74.8	− 0.5	−12.5	− 1.8
Northern Slope	7	69.1	− 0.5	−24.8	− 3.5
Middle Slope	6	75.0	− 1.4	−12.0	− 1.7
Southern Slope	6	77.6	− 2.3	− 2.8	− 0.4
Southern Plateau	13	78.8	− 0.7	− 5.8	− 0.8
Middle Plateau	9	71.9	+ 0.2	− 9.1	− 1.3
Northern Plateau	10	70.3	+ 1.4	−10.4	− 1.5
North Pacific	9	61.7	+ 1.0	−11.1	− 1.6
Middle Pacific	5	63.5	− 1.0	− 2.2	− 0.3
South Pacific	4	70.4	− 0.3	− 1.8	− 0.3

PRECIPITATION.

The distribution of precipitation is graphically shown on Chart III. On the whole a little more than the average amount of rain fell, although there were localities in which the fall was markedly deficient. Drought conditions prevailed in western New York, portions of Georgia and South Carolina, central Pennsylvania, Kentucky, central Illinois, western Iowa, eastern Nebraska, the southeastern part of South Dakota, southwestern part of Minnesota, and in lower Michigan. On the other hand, unusually heavy rains fell in North Carolina, central Florida, Alabama, Arkansas, northeastern Oklahoma and southeastern Kansas, and central Michigan.

The precipitation from January 1 to July 31 of the current year was generally slightly below normal. The deficiencies are, however, slight and of no practical importance except over very small areas. Precipitation was considerably above normal over the middle and southern slopes, as was the case a year ago, thus illustrating the tendency of a year of abundant rains being followed by another of the same character.

In Canada.—Professor Stupart says:

The distribution of rain over the Dominion during the month was, in many respects, very remarkable. This was especially the case in Ontario, where in several counties contiguous to Lakes Erie and Ontario and also on the south shores of Lake Huron, the amount of rain was exceedingly small, while in more northern localities rain fell frequently and heavily, and in some places the total fall for the month was abnormally large. A striking instance in the discrepancy in the rainfalls over different portions of the Province is shown between Wooler, near the Bay of Quinté and Ottawa City; the former place records a total fall for the month of oniy 0.3 inches, the latter 7.6 inches, and Ottawa Experimental Farm as much as 9.9 inches. The rainfall was also much above average in many portions of the Northwest Territories and throughout Quebec and the Maritime Provinces. At Montreal and Yarmouth the average amount was exceeded by 3.6 inches, and at St. John by 4.2 inches.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England	10	3.63	106	+0.2	−0.5
Middle Atlantic	12	4.25	100	0.0	−1.5
South Atlantic	10	6.63	105	+0.3	−2.3
Florida Peninsula	7	6.64	102	+0.1	−1.1
East Gulf	7	7.14	116	−1.0	−6.8
West Gulf	7	3.90	126	+0.8	−3.3
Ohio Valley and Tennessee	12	3.48	85	−0.6	−2.3
Lower Lake	8	2.68	87	−0.4	−2.8
Upper Lake	9	3.54	116	+0.5	−1.2
North Dakota	7	2.25	82	−0.5	−1.0
Upper Mississippi Valley	11	3.47	95	−0.2	+1.2
Missouri Valley	10	2.83	70	−1.2	−3.0
Northern Slope	7	1.53	94	−0.1	−0.1
Middle Slope	6	4.60	164	+1.8	+2.2
Southern Slope	6	6.73	266	+4.2	+5.0
Southern Plateau	9	2.06	132	+0.5	−1.2
Middle Plateau	13	0.42	81	−0.1	+0.7
Northern Plateau	10	0.26	46	−0.3	−1.5
North Pacific	9	0.34	33	−0.7	+3.5
Middle Pacific	5	0.00	00	0.0	−1.9
South Pacific	4	0.00	00	0.0	−1.7

HAIL.

There was much hail in several regions and, coming as it did at the time of harvest, many acres of wheat and other grains were destroyed. The destruction seems to have been greatest in the Dakotas and Minnesota, although hail fell much oftener in Colorado and Utah.

The following are the dates on which hail fell in the respective States:

Alabama, 30. Arizona, 1, 13, 19, 30, 31. California, 14. Colorado, 2, 3, 4, 7, 8, 12, 13, 14, 15, 16, 17, 22, 26, 27, 28, 29, 30. Connecticut, 12. Florida, 4. Georgia, 18. Idaho, 3, 24. Illinois, 2, 11. Indiana, 7, 28. Iowa, 6, 10, 31. Kansas, 1, 5, 7, 19, 29. Kentucky, 28. Louisiana, 4. Maryland, 12, 13, 15, 16, 23. Massachusetts and Michigan, 26. Minnesota, 2, 3, 6, 16, 25, 26, 31. Mississippi, 17. Missouri, 6, 10. Montana, 3, 4, 7, 14, 20, 21, 27, 29. Nebraska, 4, 5, 15, 31. Nevada, 1, 11, 12, 14, 28. New Hampshire, 4, 12, 21, 22. New Jersey, 8, 12, 22, 27, 29. New Mexico, 3, 19, 21. New York, 4, 12, 17. North Carolina, 8, 17. North Dakota, 8, 12, 13, 15, 22, 31. Ohio, 4, 7, 11, 13. Oklahoma, 15. Oregon, 29. Pennsylvania, 7, 12, 22, 25, 26. South Carolina, 5, 8, 17. South Dakota, 5, 14, 23, 25, 28, 30, 31. Utah, 1, 2, 3, 10, 11, 12, 13, 14, 25, 27, 29, 31. Virginia, 30. West Virginia, 5, 7. Wisconsin, 18, 24. Wyoming, 3, 4, 5, 6, 7, 12, 13, 14, 22, 25, 26, 29.

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Bismarck, N. Dak.	22	56	nw.	Miles City, Mont.	30	52	e.
Cape Henry, Va.	30	50	nw.	Mount Tamalpais, Cal.	21	61	n.
Cleveland, Ohio	7	50	nw.	New York, N. Y.	27	50	nw.
Helena, Mont.	21	55	sw.	Pocatello, Idaho.	22	52	sw.
Knoxville, Tenn.	16	60	w.	Do.	29	53	sw.
Lander, Wyo	22	52	w.	Sandusky, Ohio	7	56	nw.
Miles City, Mont.	21	62	n.				

LOCAL STORMS AND TORNADOES.

There were not so many thunderstorms during the current month as in the corresponding month of last year. There were no violent tornadoes. Three fully developed tornadoes were observed—one in Brown County, Nebr.; one in Montgomery County, Ky.; and one in Hillsboro County, N. H. A diminutive tornado was observed about twenty-five miles east of Cheyenne, Wyo., being the first known instance of the development of a tornado in that region. Tornadoes have been observed in western Kansas and indeed in eastern Colorado, but the funnel cloud and the force of the storm have suggested in each case an overgrown whirlwind rather than a well developed tornado.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table VII, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 5,476 thunderstorms were received during the current month as against 5,713 in 1898 and 5,253 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 16th, 294; 6th, 278; 5th, 272; 8th, 268.

Reports were most numerous from: Colorado, 295; Ohio, 256; New York, 244; Pennsylvania, 221.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, 18th to 26th.

The greatest number of reports were received for the following dates: 3d, 11; 7th, 5; 10th and 31st, 4.

Reports were most numerous from: Ohio, 8; Massachusetts and South Dakota, 5.

In Canada.—Auroras were reported as follows: Quebec, 10th; Montreal, 7th; Minnedosa, 4th, 7th; Swift Current, 26th; Banff, 16th.

Thunderstorms were reported as follows: St. Johns, 6th, 22d, 29th; Grand Manan, 13th, 21st, 22d; Yarmouth, 8th, 9th, 21st, 22d; Charlottetown, 5th; Father Point, 12th; Quebec, 6th, 10th, 12th, 13th, 15th, 17th, 27th; Montreal, 5th, 17th, 21st, 27th; Toronto, 4th, 28th; White River, 20th, 24th; Ottawa, 5th, 6th, 8th, 12th; Port Stanley, 5th, 8th, 11th, 29th; Saugeen, 10th; Parry Sound, 3d, 7th, 17th, 26th; Port Arthur, 20th, 22d, 24th, 26th, 27th; Winnipeg, 9th, 19th, 21st, 23d, 27th, 31st. Minnedosa, 11th, 14th, 19th, 22d, 23d, 31st; Qu'Appelle, 19th, 21st, 22d; Medicine Hat, 2d, 8d, 4th, 7th, 8th, 9th, 10th, 13th, 14th, 21st, 22d, 23d, 25th; Swift Current, 2d, 4th, 5th, 10th, 14th, 21st, 22d; Calgary, 8th, 16th; Banff, 7th, 19th, 20th, 30th, 31st; Prince Albert, 8th, 11th, 13th, 18th, 19th; Battleford, 3d, 9th, 11th, 19th, 21st, 23d, 24th, 25th, 27th; Esquimalt, 29th; Barkerville, 19th.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	79	0	Missouri Valley	67	0
Middle Atlantic	75	+ 3	Northern Slope	54	+ 2
South Atlantic	78	+ 2	Middle Slope	68	+ 7
Florida Peninsula	80	0	Southern Slope	68	+10
East Gulf	76	+ 3	Southern Plateau	41	+ 1
West Gulf	75	+ 2	Middle Plateau	50	+ 2
Ohio Valley and Tennessee	68	+ 1	Northern Plateau	40	+ 3
Lower Lake	70	+ 2	North Pacific Coast	72	+ 5
Upper Lake	77	+ 6	Middle Pacific Coast	58	+ 9
North Dakota	66	0	South Pacific Coast	64	+ 1
Upper Mississippi	68	0			

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.0	+0.1	Missouri Valley	4.8	+0.4
Middle Atlantic	5.1	+0.3	Northern Slope	4.2	+0.4
South Atlantic	5.5	+0.5	Middle Slope	4.8	+0.8
Florida Peninsula	5.8	+0.8	Southern Slope	4.4	+0.6
East Gulf	4.5	−0.5	Southern Plateau	3.3	0.0
West Gulf	4.4	+0.2	Middle Plateau	3.1	+1.1
Ohio Valley and Tennessee	4.7	+0.1	Northern Plateau	2.7	−0.4
Lower Lake	4.6	+0.1	North Pacific Coast	4.0	−0.4
Upper Lake	5.1	+0.4	Middle Pacific Coast	3.5	+0.6
North Dakota	3.3	−1.0	South Pacific Coast	2.1	−0.6
Upper Mississippi	4.4	+0.1			

NOTES ON THE WEATHER IN THE WEST INDIES.

No general disturbances were observed.

Santo Domingo: A severe local storm visited this place on the 28th. The wind blew steadily from the north and northeast with heavy rain all day, culminating in a severe squall at 7:30 p. m., maximum wind velocity, 40 miles per hour. Three small sailing vessels anchored in the outing were driven on the rocks and totally destroyed.

Basseterre: Severe thunderstorms on the 14th, maximum wind velocity, 30 miles per hour.

Curaçao: Heavy sea swell from 8 to 10 a. m. on the 29th.

Santiago: Lightning struck a cocoanut tree near the wharf and set it on fire on the afternoon of the 20th.

Puerto Principe: A fall of 20° in temperature, from 96° to 76° occurred during a thunderstorm on the 10th. Being in the interior of the island the daily range of temperature is much greater than at coast stations. During July the daily range was never less than 14°, and on two days it was as high as 27°, the average being 20°.

The rainy season had not set in over Cuba at the close of the month; the rainfall throughout the islands was generally light, except at San Juan, Porto Rico.

Chart VIII shows the pressure and temperature distribution, and the prevailing winds in the West India region for the month being a continuation of the series begun in the April 1899 REVIEW.

DESCRIPTION OF TABLES AND CHARTS.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,700 stations occupied by voluntary observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . . .).

Table III gives, for 26 stations selected out of 113 that maintain continuous records, the mean hourly temperatures deduced from the Richard thermographs described and figured in the Report of the Chief of the Weather Bureau, 1891–92, p. 29.

Table IV gives, for 26 stations selected out of 104 that maintain continuous records, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891–92, pp. 26 and 30.

Table V gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891–92, p. 19.

Table VI gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division the average resultant direction for that division can be obtained.

Table VII gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table VIII gives, for about 70 stations, the average hourly sunshine (in percentages) as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is indicated in the table by the letter T or P in the column following the name of the station.

Table IX gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes..	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates pr. hr. (ins.)..	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table X gives the record of excessive precipitation at all stations from which reports are received.

Table XI gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

NOTES EXPLANATORY OF THE CHARTS.

Chart I, tracks of centers of high areas, and Chart II, tracks of centers of low areas, are constructed in the same way. The roman numerals show number and chronological order of highs (Chart I) and lows (Chart II). The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. Within each circle is also given (Chart I) the highest barometric reading and (Chart II) the lowest pressure at or near the center at that time.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all, by 0.0.

Chart IV.—Sea-level pressure, temperature, and resultant surface winds. The wind directions on this Chart are the computed resultants of observations at 8 a. m. and 8 p. m., daily; the resultant duration is shown by figures attached to each arrow. The temperatures are the means of daily maxima and minima and are reduced to sea level. The pressures are the means of 8 a. m. and 8 p. m. observations, daily, and are reduced to sea level and to standard gravity. The reduction for 30 inches of the mercurial barometer, as formerly shown by the marginal figures for each degree of latitude, has already been applied.

Chart V.—Hydrographs for seven principal rivers of the United States.

Chart VI.—Surface temperatures; maximum, minimum, and mean. Lines of equal monthly mean temperature in red; lines of equal maximum temperature in black; and lines of equal minimum temperature (dotted) also in black.

Chart VII.—Percentage of sunshine. The average cloudiness at each Weather Bureau station is determined by numerous personal observations during the day. The difference between the observed cloudiness and 100, it is assumed, represents the percentage of sunshine, and the values thus obtained have been used in preparing Chart VII.

Charts VIII.—Sea-level pressure, temperature, and resultant surface winds, West Indian stations, for July. See explanation under Chart IV.

TABLE I.—*Climatological data for Weather Bureau Stations, July,* 1899.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Mean actual, 8 a. m. and 8 p. m. + 2.	Mean reduced.	Departure from normal.	Mean max. and min. + 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.				
New England.							68.5	+ 0.3									72	3.63	+ 0.2									5.0	
Eastport	76	69	74	29.84	29.93	+ .01	59.2	− 1.2	80	11	66	48	1	52	27	56	54	86	4.78	+ 0.9	11	6,015	s.	26	sw.	30	7	12	12	6.2	
Portland, Me	103	81	89	29.79	29.89	− .03	67.9	− 0.6	87	4	76	48	30	60	25	61	57	72	3.92	+ 0.4	12	5,378	s.	29	nw.	30	11	11	9	5.4	
Northfield	872	15	65	29.02	29.93	− .01	65.3	+ 0.2	90	2	77	37	1	54	45	60	57	75	3.41	+ 0.2	18	5,850	s.	42	sw.	3	3	21	7	6.1	
Boston	125	115	181	29.82	29.95	+ .02	72.6	+ 1.3	94	4	82	55	1	64	27	64	60	67	2.52	− 0.9	9	8,187	sw.	34	sw.	21	18	8	5	3.3	
Nantucket	14	43	54	29.97	29.98	+ .02	68.6	+ 1.4	82	18	74	55	24	63	18	65	64	87	1.99	− 0.4	12	7,455	sw.	27	sw.	21	9	13	9	5.7	
Woods Hole	22	11	57	29.95	29.97	+ .01	69.5	+ 1.3	81	15	75	59	*	64	18	65	64	85	3.36	+ 0.3	10	10,736	sw.	48	s.	8	15	6	10	4.7	
Vineyard Haven	.....	20	55	.....	.....	.....	71.5	+ 0.6	85	17	79	57	1	64	22	.....	.....	.....	3.86	+ 0.9	9	6,788	sw.	26	sw.	8	11	10	10	5.4	
Block Island	27	11	48	29.94	29.97	+ .01	68.4	0.0	80	*	74	52	1	63	19	65	63	84	4.49	+ 1.3	13	10,534	sw.	34	sw.	25	18	7	6	3.6	
Narragansett	.....	10	.....	.....	.....	.....	70.4	+ 0.2	85	17	78	49	1	62	26	.....	.....	.....	3.79	+ 0.6	9	.....	sw.	.....	.....	.....	23	2	6	.....	
New Haven	107	118	140	29.85	29.96	.00	71.5	− 0.3	90	27	80	51	1	63	27	65	62	76	4.17	+ 0.8	9	5,375	sw.	30	s.	16	15	9	7	4.3	
Mid. Atlan. States.							74.7	0.0										75	4.25	0.0									5.1	
Albany	97	84	113	29.84	29.95	+ .03	73.2	+ 0.8	94	27	83	50	20	64	30	65	60	68	2.69	− 1.3	12	5,858	s.	24	se.	29	9	14	8	5.8	
Binghamton	875	79	90	.....	.....	.....	70.2	+ 1.5	91	4	81	43	1	59	38	.....	.....	.....	1.84	− 1.4	13	4,062	nw.	24	sw.	29	8	14	9	5.8	
New York	314	313	346	29.64	29.97	.00	73.8	+ 0.3	90	27	81	59	1	66	22	66	63	74	6.30	+ 1.9	14	9,483	s.	50	nw.	27	9	14	8	5.2	
Harrisburg	377	94	104	.....	.....	.....	75.1	+ 2.2	94	22	84	55	1	66	27	.....	.....	.....	1.90	− 2.4	10	3,981	w.	23	nw.	22	9	11	11	5.4	
Philadelphia	117	108	184	29.86	29.98	.00	76.7	+ 1.0	96	22	86	60	1	68	26	68	64	71	4.69	+ 0.5	11	7,178	sw.	34	sw.	8	9	12	10	5.6	
Atlantic City	52	68	76	29.94	29.99	+ .03	70.4	− 1.5	88	13	76	60	1	64	24	67	66	86	4.78	+ 1.4	10	7,505	sw.	42	nw.	27	11	15	5	4.7	
Cape May	24	52	70	29.98	30.00	.....	69.7	− 3.9	84	13	75	62	1	64	20	67	.....	.....	3.34	+ 0.1	12	9,177	s.	43	w.	16	13	13	5	4.6	
Baltimore	123	68	82	29.85	29.97	+ .01	77.6	+ 0.4	96	22	87	59	1	68	28	69	65	69	1.64	− 3.1	10	3,355	sw.	19	sw.	5	9	16	6	4.6	
Washington	112	59	76	29.87	29.99	+ .02	76.6	− 0.2	94	22	86	54	1	67	30	69	66	75	6.06	+ 1.5	12	4,146	s.	36	nw.	16	12	14	5	4.4	
Cape Henry	.....	5	34	.....	.....	.....	77.4	+ 0.4	98	16	85	58	1	70	27	.....	.....	.....	8.11	+ 2.5	18	8,161	s.	50	nw.	30	11	6	14	5.9	
Lynchburg	685	83	88	29.27	29.99	+ .01	76.5	− 1.0	95	16	87	53	1	66	30	69	66	73	3.87	0.0	10	2,189	sw.	41	sw.	5	12	13	6	4.9	
Norfolk	92	102	111	29.92	30.01	+ .02	78.8	+ 0.3	95	30	87	61	1	70	24	73	72	86	5.87	0.0	18	6,372	s.	40	nw.	17	13	12	6	4.7	
Richmond	144	98	105	.....	.....	.....	79.0	.....	96	16	89	60	1	69	27	.....	.....	.....	4.12	.....	10	4,218	se.	26	sw.	17	11	10	10	5.3	
S. Atlantic States.							79.6	− 0.3										73	6.63	+ 0.3									5.5	
Charlotte	773	68	76	29.21	30.00	.00	78.6	+ 0.4	100	16	89	58	1	68	28	68	63	67	5.96	+ 0.4	11	4,305	sw.	31	w.	8	8	8	15	6.0	
Hatteras	11	17	36	30.03	30.04	+ .04	78.0	+ 0.1	86	29	82	68	1	74	13	74	72	83	9.50	+ 3.1	14	9,107	s.	46	nw.	30	12	13	6	4.9	
Kittyhawk	9	12	30	.....	.....	.....	77.6	− 0.4	95	30	85	58	1	70	22	.....	.....	.....	8.70	+ 2.9	14	9,476	.....	.....	.....	.....	14	9	8	5.1	
Raleigh	375	98	101	29.63	30.01	.00	77.6	+ 0.5	95	16	87	58	1	68	27	70	68	78	8.85	+ 1.0	18	3,610	sw.	36	nw.	16	9	12	10	5.4	
Wilmington	78	82	90	29.95	30.03	+ .03	78.0	− 1.7	92	29	84	61	1	72	21	73	71	82	8.05	+ 0.8	14	6,599	sw.	28	sw.	26	7	13	11	6.0	
Charleston	48	14	92	30.00	30.05	+ .04	80.8	− 1.0	96	29	86	70	1	76	17	74	72	77	5.11	− 2.5	12	8,945	s.	30	e.	1	4	22	5	5.2	
Columbia	.....	5	.....	.....	.....	.....	82.0	+ 0.7	105	15	93	61	2	71	31	.....	.....	.....	5.27	− 0.3	12	.....	sw.	.....	.....	.....	7	12	12	5.9	
Augusta	180	89	103	29.81	30.00	+ .02	81.2	+ 0.1	100	15	91	61	2	71	27	72	68	71	3.74	− 1.5	8	3,854	s.	36	nw.	7	9	11	11	5.1	
Savannah	65	63	89	29.94	30.02	.00	81.3	− 0.6	98	15	89	65	2	73	25	74	72	80	4.97	− 0.8	10	6,119	sw.	30	sw.	6	9	16	6	5.1	
Jacksonville	43	69	84	29.98	30.03	+ .02	81.2	− 0.9	96	15	90	67	5	73	25	75	73	84	6.12	− 0.4	13	5,462	sw.	42	w.	5	6	14	11	6.2	
Florida Peninsula.							81.1	− 0.9										80	7.50	+ 1.4									5.8	
Jupiter	28	13	30	30.00	30.03	− .02	80.9	+ 0.1	91	31	87	71	2	75	18	76	74	81	3.35	− 1.4	14	6,432	se.	34	se.	24	13	12	6	4.6	
Key West	22	43	50	30.00	30.02	+ .01	82.7	− 1.2	90	4	87	69	1	78	18	77	74	77	3.61	− 0.2	15	5,209	e.	44	nw.	1	6	18	7	5.5	
Tampa	36	60	67	29.97	30.01	− .01	79.8	− 1.6	94	28	87	68	1	73	21	74	73	83	15.53	+ 5.7	19	4,247	e.	37	s.	31	1	20	10	7.2	
East Gulf States.							81.1	+ 0.1										76	7.14	+ 1.0									4.5	
Atlanta	1,191	139	156	28.81	30.02	− .02	79.2	+ 0.8	97	17	88	62	2	70	28	69	64	67	6.42	+ 1.5	15	5,780	sw.	44	nw.	17	12	10	9	5.4	
Macon	370	.....	.....	.....	.....	.....	80.6	.....	100	16	91	60	2	70	31	.....	.....	.....	2.47	.....	13	3,763	sw.	30	nw.	8	4	26	1	4.8	
Pensacola	56	78	90	.....	.....	.....	81.0	+ 0.2	95	31	87	70	11	75	17	.....	.....	.....	7.59	+ 0.9	15	5,668	nw.	38	sw.	5	9	14	8	5.2	
Mobile	57	88	96	29.95	30.01	+ .01	81.0	− 0.2	96	30	89	69	11	73	22	76	74	84	9.80	+ 3.3	14	3,919	sw.	27	w.	24	18	13	0	3.1	
Montgomery	221	100	112	29.78	30.01	.00	81.4	− 0.1	98	17	92	64	3	71	27	72	70	77	13.42	+ 8.9	10	4,127	s.	33	sw.	22	12	10	9	4.9	
Meridian	375	84	94	.....	.....	.....	79.3	− 0.7	96	17	90	59	3	69	31	.....	.....	.....	5.76	− 1.1	13	3,084	sw.	26	n.	23	7	18	6	5.6	
Vicksburg	247	65	73	29.71	29.97	− .05	81.6	+ 0.3	94	30	91	64	10	72	25	74	72	77	2.50	− 2.0	9	3,489	sw.	29	nw.	7	15	15	1	3.6	
New Orleans	54	112	120	29.94	30.00	+ .01	82.6	+ 0.4	93	21	89	69	4	76	18	75	72	75	5.45	− 1.0	13	4,536	sw.	27	se.	3	15	14	2	3.7	
Port Eads	.....	27	...	.....	.....	.....	82.4	+ 0.1	92	30	88	70	*	77	17	.....	.....	..	6.16	− 2.2	8	.....	w.	....	....	...	2	20	9	....	
West Gulf States.							81.9	0.0										75	3.90	+ 0.8									4.4	
Shreveport	249	77	84	29.72	29.98	− .01	83.2	+ 0.7	101	29	94	62	11	72	30	72	68	68	0.98	− 2.6	9	3,685	s.	26	s.	3	12	8	11	5.0	
Fort Smith	457	74	82	29.48	29.95	.00	80.1	+ 0.1	95	31	90	62	10	71	26	73	70	74	5.14	+ 0.7	9	3,410	e.	30	sw.	17	13	10	8	4.7	
Little Rock	357	93	100	29.61	29.98	.00	79.5	− 0.8	94	31	89	62	10	70	27	72	69	76	7.34	+ 3.3	12	4,108	ne.	30	s.	17	16	5	10	4.6	
Corpus Christi	20	42	50	29.94	29.96	− .02	82.8	+ 1.1	98	26	87	75	10	79	15	77	76	83	0.43	− 0.9	2	9,380	se.	27	se.	4	19	9	3	2.9	
Fort Worth	670	106	114	.....	.....	.....	81.4	.....	102	23	91	64	*	71	27	.....	.....	.....	1.66	.....	9	5,658	sw.	36	sw.	3	15	16	0	3.9	
Galveston	54	85	96	29.91	29.96	− .03	83.3	− 0.6	91	9	87	72	27	79	13	76	73	75	6.02	+ 2.9	6	5,869	s.	36	se.	27	11	16	4	4.7	
Palestine	510	54	61	29.44	29.97	− .02	81.3	− 0.2	97	25	91	63	11	72	26	73	71	77	4.52	+ 1.9	9	3,906	se.	28	nw.	19	9	17	5	5.4	
San Antonio	704	95	104	29.22	29.94	− .02	82.8	− 0.5	100	23	93	66	12	73	26	72	68	69	2.85	+ 0.6	8	5,755	se.	30	e.	14	15	10	6	4.2	
Ohio Val. & Tenn.							77.4	+ 0.3										68	3.46	− 0.6									4.7	
Chattanooga	762	106	112	29.23	30.01	.00	78.6	+ 0.8	98	15	88	61	2	69	31	68	63	65	2.27	− 2.0	13	4,029	sw.	27	s.	20	9	14	8	5.2	
Knoxville	1,004	10	88	28.98	30.01	− .02	76.8	+ 0.4	98	15	87	58	9	66	31	68	65	72	3.93	− 0.4	13	3,976	ne.	60	w.	16	17	11	3	3.6	
Memphis	399	140	154	29.57	29.98	− .01	80.0	− 0.7	94	14	88	65	10	72	21	71	68	72	5.86	+ 2.4	8	3,742	sw.	35	w.	4	10	14	7	4.8	
Nashville	545	128	134	29.44	30.00	+ .02	79.6	+ 0.3	96	16	90	60	10	69	31	69	63	63	6.44	+ 2.1	10	4,131	w.	29	se.	24	12	11	8	4.8	
Lexington	990	75	102	.....	.....	.....	77.2	+ 1.5	95	16	88	58	9	67	30	.....	.....	.....	0.97	− 4.1	8	5,856	sw.	42	w.	16	9	15	7	5.1	
Louisville	525	114	136	29.44	29.99	+ .01	78.6	+ 0.2	95	14	89	59	10	68	28	68	63	66	2.09	− 1.7	9	3,643	sw.	22	n.	8	10	11	10	5.3	
Evansville	434	72	82	.....	.....	.....	78.2	.....	94	14	88	58	9	69	30	.....	.....	.....	3.27	.....	14	3,892	ne.	36	s.	7	15	10	6	4.2	
Indianapolis	823	154	164	29.14	29.98	− .01	75.6	− 0.6	94	12	86	52	9	66	29	65	60	60	3.64	− 0.6	9	5,636	sw.	36	sw.	27	11	9	11	5.0	
Cincinnati	628	152	157	29.34	30.00	+ .02	76.9	− 0.5	94	24	87	56	9	67	28	67	62	65	1.58	− 1.8	10	4,463	se.	36	sw.	7	13	12	6	4.2	
Columbus	824	87	100	29.12	29.98	.00	76.2	+ 1.3	94	3	87	55	1	65	33	67	63	70	4.85	+ 1.6	14	4,498	sw.	36	sw.	5	11	15	5	4.5	
Pittsburg	842	116	123	29.11	29.98	.00	75.6	+ 0.6	95	23	86	55	10	66	30	68	65	75	3.13	− 1.6	13	3,265	n.	20	sw.	4	15	12	4	3.6	
Parkersburg	638	77	84	29.35	30.01	− .01	76.0	+ 2.5	98	23	87	51	1	65	36	67	64	70	3.56	− 0.8	11	3,316	se.	35	nw.	15	11	11	9	5.1	
Elkins	1,940	41	51	.....	.....	.....	69.4	.....	90	3	82	45	10	57	37	.....	.....	.....	5.87	.....	15	2,342	w.	30	n.	13	10	6	15	5.7	
Lower Lake Region.							71.5	+ 0.3										70	2.68	− 0.4									4.6	
Buffalo	768	178	206	29.14	29.94	.00	70.0	+ 0.3	91	24	76	58	31	64	27	67	65	82	2.60	− 0.6	9	8,587	sw.	42	w.	8	5	21	5	5.4	
Oswego	335	76	87	29.57	29.93	− .03	69.2	+ 0.2	89	3	77	52	30	61	28	63	58	70	1.68	− 1.4	8	6,352	sw.	26	ne.	18	14	10	7	4.5	
Rochester	523	81	90	29.39	29.94	.00	71.6	+ 1.2	94	3	82	54	31	61	32	62	57	64	1.96	− 1.0	11	5,030	sw.	24	sw.	21	19	11	1	3.1	
Erie	714	92	102	29.23	29.97	+ .01	71.0	0.0	89	3	78	53	10	64	32	65	61	72	2.60	− 0.2	10	6,751	w.	29	nw.	17	13	14	4	4.6	
Cleveland	762	190	201	29.17	29.96	− .02	72.0	+ 0.5	92	5	79	55	1	65	34	65	60	68	3.94	+ 0.4	11	8,149	nw.	50	nw.	7	12	15	4	4.4	
Sandusky	629	62	74	29.31	29.96	− .02	73.6	+ 0.5	96	4	82	57	8	66	27	66	62	70	3.44	+ 0.3	14	4,864	sw.	56	nw.	7	10	8	13	5.8	
Toledo	628	128	127	29.31	29.97	.00	73.3	− 0.1	93	4	83	54	9	64	30	64	59	65	2.27	− 0.7	9	5,383	sw.	28	w.	5	14	9	8	4.4	
Detroit	730	160	166	29.19	29.95	− .02	71.5	− 0.1	90	4	80	56	9	63	26	64	60	70	2.95	− 0.4	9	5,688	sw.	24	sw.	20	11	14	6	4.8	
Upper Lake Region.							66.7	− 0.6										77	3.54	+ 0.5									5.1	
Alpena	609	61	65	29.31	29.96	+ .01	64.2	− 1.1	87	1	72	48	31	56	29	60	57	79	6.58	+ 3.7	15	4,663	se.	25	s.	7	11	15	5	5.0	
Escanaba	612	43	57	29.31	29.96	+ .03	64.9	− 1.8	89	25	74	45	9	56	27	61	59	80	1.63	− 1.6	8	5,966	s.	31	n.	7	11	9	11	5.5	
Grand Haven	628	55	64	29.29	29.96	.00	68.5	− 0.3	93	23	76	50	9	60	29	63	60	76	3.57	+ 0.9	12	5,267	w.	27	sw.	26	11	14	6	4.6	
Marquette	734	67	95	29.16	29.93	− .02	64.0	− 0.9	89	23	72	46	7	56	27	59	55	76	2.82	− 0.2	10	5,802	n.	33	sw.	1	4	17	10	6.4	
Port Huron	639	70	108	29.31	29.98	+ .03	68.4	− 0.1	89	4	78	50	30	59	29	62	58	78	1.92	− 0.5	9	6,709	n.	37	n.	8	13	12	6	4.6	
Sault Ste. Marie	614	40	60	29.29	29.94	− .02	61.4	− 0.4	84	28	72	42	19	51	33	57	55	81	2.90	− 0.1	9	5,997	w.	37	nw.	30	7	17	7	4.8	
Chicago	834	241	274	29.12	29.97	.00	72.2	+ 0.2	90	26	79	59	8	66	32	67	65	81	6.66	+ 3.2	11	9,165	ne.	37	ne.	16	12	14	5	4.5	
Milwaukee	681	124	142	29.26	29.97	.00	69.0	− 0.2	90	26	76	56	30	62	25	62	59	75	2.56	− 0.5	11	6,188	ne.	35	sw.	28	9	11	11	5.7	
Green Bay	617	49	57	29.31	29.96	− .02	69.2	− 0.8	90	23	79	50	9	60	35	63	60	76	4.99	+ 2.0	12	4,824	ne.	27	n.	7	12	11	8	5.0	
Duluth	702	95	106	29.20	29.94	+ .02	64.8	− 1.1	87	25	73	49	6	56	32	59	55	78	1.82	− 1.9	11	6,606	ne.	34	nw.	28	10	15	6	4.9	
North Dakota.							63.5	0.0										66	1.63	− 1.2									3.3	
Moorhead	935	54	60	28.95	29.93	+ .02	69.0	+ 1.4	96	19	81	42	30	57	40	62	59	72	2.52	− 1.4	9	6,082	nw.	34	nw.	5	18	8	5	3.5	
Bismarck	1,674	16	29	28.22	29.93	+ .03	69.4	− 0.1	100	19	82	41	29	57	43	61	56	65	0.45	− 1.9	4	5,725	nw.	56	nw.	22	19	10	2	3.5	
Williston	1,872	15	31	28.00	29.92	+ .04	67.2	− 1.3	92	18	81	40	29	54	39	59	53	62	1.91	− 0.2	8	5,691	n.	42	w.	21	24	7	0	2.8	

TABLE I.—*Climatological data for Weather Bureau Stations, July*, 1899—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. and 8 p. m. + 2.	Pressure, in inches: Mean reduced.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. and min. + 2.	Temperature of the air: Departure from normal.	Temperature of the air: Maximum.	Temperature of the air: Date.	Temperature of the air: Mean maximum.	Temperature of the air: Minimum.	Temperature of the air: Date.	Temperature of the air: Mean minimum.	Temperature of the air: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
Upper Miss. Valley.							75.1	— 0.1										68	3.47	— 0.2										4.4	
Minneapolis	.....	99	208	.....	.....	.....	73.4	+ 1.8	92	21	83	53	30	63	31	....	....	....	1.54	— 2.3	8	5,508	sw.	39	n.	16	7	16	8	....	
St. Paul	837	114	124	29.06	29.94	— .01	72.9	+ 1.4	91	18	83	52	30	63	31	64	59	66	1.51	— 1.8	11	4,813	sw.	36	nw.	28	10	18	3	4.3	
La Crosse	720	70	78	.....	.....	.....	73.0	+ 0.1	92	21	83	48	30	63	31	....	....	....	4.10	0.0	7	3,811	s.	24	sw.	16	16	10	5	4.3	
Davenport	606	71	79	29.32	29.96	— .02	75.2	+ 0.2	94	26	85	54	30	66	27	67	63	68	2.84	— 0.8	7	4,020	sw.	35	w.	7	16	8	7	4.2	
Des Moines	867	84	88	29.08	29.99	+ .03	73.5	— 1.0	91	11	84	52	30	64	30	66	61	69	3.20	— 0.3	9	4,063	sw.	36	sw.	6	12	15	4	4.6	
Dubuque	698	101	109	29.23	29.95	— .01	74.0	— 0.3	92	21	84	51	30	64	28	65	61	66	4.12	— 0.2	9	4,199	nw.	25	nw.	26	16	12	3	3.8	
Keokuk	614	64	78	29.34	29.97	+ .01	76.0	— 0.9	95	26	85	56	30	67	28	68	64	68	5.39	+ 1.8	8	3,937	sw.	20	se.	31	16	8	7	3.7	
Cairo	359	87	93	29.61	29.98	+ .01	77.8	— 1.1	92	14	86	62	9	70	23	71	68	77	3.90	+ 0.4	10	4,040	sw.	44	sw.	28	10	13	8	4.8	
Springfield, Ill.	644	82	92	29.31	29.97	— .01	76.2	+ 0.2	95	26	86	58	30	66	29	67	62	66	1.51	+ 1.2	9	4,842	nw.	27	sw.	3	9	9	13	5.3	
Hannibal	534	75	107	.....	.....	.....	75.7	— 1.0	95	26	85	55	9	66	31	....	....	....	5.49	+ 1.6	8	4,437	sw.	37	sw.	12	16	11	4	3.8	
St. Louis	567	111	210	29.38	29.97	.00	78.8	0.0	93	27	87	63	9	71	24	69	65	67	4.54	+ 0.8	12	5,254	s.	31	w.	3	10	8	13	5.2	
Missouri Valley.							74.3	— 0.5										67	2.83	— 1.2										4.3	
Columbia	783	4	84	.....	.....	.....	75.3	— 0.8	95	26	87	52	9	64	31	....	....	....	3.75	— 1.1	9	3,897	sw.	30	n.	31	9	14	8	5.6	
Kansas City	963	78	95	28.99	29.97	+ .02	76.2	— 1.3	93	28	84	59	8	68	25	68	64	69	5.57	+ 1.4	9	4,427	se.	38	nw.	6	8	15	8	5.1	
Springfield, Mo.	1,334	100	103	28.62	29.97	+ .01	76.2	+ 0.5	93	26	85	59	9	67	34	69	66	76	1.69	— 3.1	9	5,255	s.	33	n.	6	13	13	5	4.6	
Topeka	.....	81	....	.....	.....	.....	76.0	— 1.4	94	26	86	59	8	66	29	....	....	....	6.40	+ 1.3	14	.....	e.	....	.....	...	6	17	8	5.2	
Lincoln	1,199	74	84	28.72	29.96	+ .02	74.4	— 2.4	94	25	85	55	8	64	39	66	62	71	1.47	— 2.4	7	5,588	s.	36	nw.	2	12	13	6	4.5	
Omaha	1,105	115	123	28.81	29.94	.00	75.0	— 1.2	92	10	84	58	8	66	25	67	63	72	1.73	— 3.0	7	4,756	se.	27	n.	29	9	10	12	5.7	
Sioux City	1,139	96	164	.....	.....	.....	73.5	— 0.8	94	20	85	54	*	62	32	....	....	....	1.00	— 2.3	5	6,966	s.	39	s.	5	16	5	10	4.3	
Pierre	1,572	50	62	28.30	29.90	— .01	75.8	+ 1.2	106	22	89	45	29	63	40	62	53	51	2.88	+ 0.7	6	7,393	se.	42	ne.	22	16	11	4	3.8	
Huron	1,306	56	67	28.58	29.93	— .01	72.4	+ 1.5	104	25	87	44	29	58	43	62	56	64	0.90	— 2.2	3	7,904	se.	38	se.	22	13	17	1	4.3	
Yankton	1,234	52	58	.....	.....	.....	73.6	0.0	97	20	84	52	29	63	31	....	....	....	2.87	— 1.0	6	5,185	s.	36	s.	25	12	16	3	4.4	
Northern Slope.							69.1	— 0.5										54	1.53	— 0.1										4.2	
Havre	2,494	46	47	27.35	29.89	+ .01	68.1	+ 0.6	99	18	82	43	29	54	40	57	48	56	1.45	— 0.8	8	5,707	w.	46	w.	22	24	7	0	2.9	
Miles City	2,371	42	50	27.47	29.87	— .02	71.8	— 1.9	101	20	87	44	29	57	46	61	55	61	1.88	+ 0.5	9	3,493	n.	62	n.	21	17	11	3	4.0	
Helena	4,108	88	93	25.89	29.96	+ .05	67.6	+ 0.4	98	18	81	43	28	54	38	52	37	40	0.63	— 0.5	7	5,720	sw.	55	sw.	21	15	10	6	4.2	
Kalispell	2,964	45	51	26.93	29.95	.....	64.0	.....	89	18	79	41	6	49	40	52	43	55	1.10	.....	5	4,587	nw.	31	n.	24	18	10	3	3.4	
Rapid City	3,251	46	50	26.63	29.87	— .03	71.8	+ 0.5	102	21	85	48	29	59	41	59	50	53	0.96	— 0.7	12	3,511	w.	30	nw.	31	14	15	2	3.7	
Cheyenne	6,084	58	60	24.12	29.92	+ .05	65.6	— 1.3	91	25	80	45	4	51	39	53	42	53	3.28	+ 1.5	17	6,402	s.	38	nw.	4	5	18	8	6.0	
Lander	5,372	28	36	24.72	29.94	+ .03	66.2	— 0.8	93	21	82	40	23	50	42	52	39	47	0.46	— 0.3	7	3,463	sw.	52	w.	22	12	13	6	4.6	
North Platte	2,826	43	52	27.10	29.94	+ .03	72.6	— 0.9	101	25	84	52	24	61	35	63	58	68	2.04	— 0.7	8	6,040	s.	32	w.	31	14	15	2	4.5	
Middle Slope.							75.0	— 1.4										63	4.60	+ 1.3										4.3	
Denver	5,290	79	151	24.82	29.94	+ .09	70.4	— 1.3	95	25	84	51	4	57	39	57	47	54	1.92	+ 0.2	14	5,519	sw.	35	nw.	3	12	15	4	4.5	
Pueblo	4,682	74	81	25.36	29.94	+ .07	72.2	— 1.8	96	31	85	54	4	60	40	59	51	58	4.06	+ 1.9	15	5,112	se.	39	nw	7	14	13	4	4.6	
Concordia	1,398	42	47	28.53	29.96	+ .03	75.8	— 1.3	97	26	86	57	25	65	37	68	64	72	4.24	+ 1.1	8	3,308	s.	20	sw.	28	6	16	9	5.8	
Dodge	2,504	44	52	27.41	29.93	+ .04	75.4	— 2.2	96	6	86	58	29	65	28	67	64	74	6.56	+ 3.4	12	6,393	se.	34	se.	12	13	12	6	5.0	
Wichita	1,351	78	85	28.57	29.95	+ .03	77.4	— 1.0	96	31	87	58	30	68	28	69	66	74	4.62	+ 1.6	10	4,325	s.	30	nw.	7	12	12	7	5.0	
Oklahoma	1,218	54	62	28.70	29.95	+ .03	78.8	— 0.9	92	31	87	66	9	70	22	71	68	75	6.17	+ 2.4	11	5,455	s.	30	ne	7	15	11	5	3.6	
Southern Slope.							77.6	— 1.3										68	4.17	+ 2.2										4.4	
Abilene	1,749	45	54	28.18	29.94	+ .01	81.4	— 1.3	102	23	92	64	12	71	27	70	66	66	1.38	— 0.3	4	5,789	se.	26	sw.	1	16	13	2	3.5	
Amarillo	3,691	54	61	26.29	29.94	+ .02	73.8	— 2.2	96	23	83	60	1	64	31	65	61	71	6.96	+ 4.8	12	5,869	s.	40	ne.	23	9	11	11	5.3	
Southern Plateau.							82.2	— 0.2										41	1.73	+ 0.5										3.3	
El Paso	3,767	10	110	26.16	29.84	+ .01	80.8	— 1.1	99	5	92	64	18	70	30	64	54	49	3.08	+ 1.0	9	7,348	ne.	44	ne.	3	8	17	6	4.6	
Santa Fe	6,998	47	50	23.37	29.93	+ .02	67.5	— 1.0	84	22	78	52	9	57	30	56	48	59	4.71	+ 1.9	20	4,060	se.	27	e.	7	10	16	5	4.9	
Flagstaff	6,885	12	25	23.44	29.99	.....	64.8	.... ..	84	1	79	42	4	50	38	54	....	....	2.62	.....	17	.....	sw.	....	.....	...	1	16	14	4.2	
Phenix	1,076	47	57	28.66	29.78	— .04	91.0	+ 1.1	112	1	104	68	19	78	32	70	59	40	0.87	0.0	6	3,480	e.	32	e.	31	15	16	0	3.6	
Yuma	139	16	50	29.57	29.71	— .06	91.3	— 0.2	111	1	105	71	4	78	35	72	62	45	T.	— 0.1	0	5,107	sw.	41	ne.	18	27	4	0	1.6	
Independence	3,907	10	58	25.92	29.71	— .07	80.4	+ 0.1	100	18	94	62	7	67	33	54	21	18	0.01	— 0.1	1	5,860	nw.	44	sw.	19	28	3	0	0.7	
Middle Plateau.							72.2	+ 0.6										30	0.15	— 0.1										3.1	
Carson City	4,720	82	92	25.28	29.89	+ .06	68.8	+ 0.9	95	18	86	39	11	52	45	51	32	33	T.	— 0.2	0	5,305	w.	36	sw.	24	28	3	0	0.8	
Winnemucca	4,340	59	70	25.64	29.86	+ .03	71.6	+ 0.2	98	19	89	45	9	54	49	51	26	24	0.16	0.0	1	6,991	sw.	42	sw.	25	19	10	2	2.5	
Cedar City	5,850	36	47	24.31	29.88	.....	74 6	.... ..	90	27	86	57	11	63	29	55	37	30	0.47	.....	7	4,972	se.	30	se.	10	11	13	7	4.8	
Salt Lake City	4,344	83	90	25.60	29.84	— .01	76.2	+ 0.7	97	24	89	51	23	63	41	56	39	30	0.42	— 0.1	6	4,348	se.	32	n.	15	19	10	2	3.1	
Grand Junction	4,608	43	50	25.39	29.86	.....	77.3	.....	98	21	92	55	3	63	36	57	40	35	0.18	....	3	3,885	se.	31	s.	10	10	17	4	4.5	
Northern Plateau.							71.7	+ 1.2										40	0.17	— 0.3										2.7	
Baker City	3,470	49	55	26.43	29.91	— .03	67.2	+ 1.2	96	17	83	41	5	51	41	51	36	38	0.38	— 0.2	3	4,245	s.	22	sw.	9	18	10	3	2.8	
Boise	2,736	61	68	27.10	29.84	— .04	74.5	+ 1.4	102	18	91	47	23	58	39	59	49	45	0.01	— 0.2	1	3,228	w.	26	ne.	13	26	3	2	2.0	
Pocatello	4,482	48	56	25.52	29.90	.....	71.4	.....	96	19	87	44	23	56	41	54	39	39	0.15	— 0.3	4	7,683	se.	53	sw.	29	19	8	4	3.5	
Spokane	1,943	99	107	27.94	29.93	+ .01	70.0	+ 1.0	98	16	85	45	5	55	42	54	41	44	0.30	— 0.4	5	4,470	ne.	36	s.	3	18	9	4	3.4	
Walla Walla	1,018	65	73	28.87	29.91	— .03	75.2	+ 1.2	102	*	90	47	1	60	39	57	42	35	T.	— 0.3	0	4,442	s.	24	w.	3	25	6	0	1.9	
N. Pac. Coast Reg.							61.7	+ 0.1										72	0.34	— 0.7										4.0	
Fort Canby	179	10	34	29.90	30.09	+ .03	58.4	— 0.1	77	25	63	51	4	54	21	55	53	86	0.52	— 0.6	10	5,664	n.	28	n.	1	8	9	14	6.3	
Neah	50	7	24	30.02	30.07	.00	57.0	— 1.9	78	26	63	45	7	51	27	54	52	84	0.33	— 1.9	7	5,276	w.	26	w.	15	14	1	16	5.5	
Port Crescent	256	15	20	.....	.....	.....	57.2	+ 0.9	89	26	66	39	1	48	37	....	....	....	0.08	— 0.5	2	4,228	w.	18	w.	20	18	9	4	3.2	
Seattle	119	114	121	29.92	30.05	— .02	65.0	+ 1.8	90	26	75	50	7	55	31	57	51	66	0.43	— 0.6	4	3,508	nw.	18	nw.	25	18	4	9	3.9	
Tacoma	213	113	120	.....	.....	.....	61.8	+ 0.3	86	25	70	48	1	54	32	....	....	....	0.52	— 0.6	5	.....	w.	....	.....	...	16	3	12	....	
Astoria	.....	18	....	.....	.....	.....	61.8	+ 0.3	86	25	70	48	1	54	32	....	....	....	0.52	— 0.6	5	.....	w.	....	.....	...	16	3	12	....	
Portland, Oreg	153	208	213	29.86	30.02	— .01	66.8	+ 0.5	98	26	78	51	10	56	30	58	51	63	0.47	— 0.1	2	5,347	nw.	22	nw.	4	17	10	4	2.9	
Roseburg	521	56	67	29.43	29.99	— .04	65.7	— 0.6	92	27	80	44	22	52	40	56	49	62	0.00	— 0.5	0	3,424	ne.	19	nw.	3	23	6	2	1.9	
Mid. Pac. C'st Reg.							63.5	— 1.0										68	0.00	0.0										3.5	
Eureka	64	60	69	29.99	30.05	.00	54.8	— 1.0	62	29	59	46	8	51	14	52	50	86	0.00	— 0.1	0	4,694	nw.	30	nw.	4	10	5	16	6.3	
Mount Tamalpais	2,375	11	18	27.50	29.90	.....	71.0	.....	96	18	78	46	25	64	28	53	33	30	0.00	.....	0	13,108	nw.	61	n.	21	29	2	0	1.2	
Red Bluff	334	54	58	29.48	29.82	— .03	82.0	+ 0.2	109	19	98	60	7	66	39	61	44	31	0.00	0.0	0	3,790	se.	24	n.	22	31	0	0	0.4	
Sacramento	71	106	117	29.76	29.83	— .04	72.1	— 0.5	102	18	89	49	12	55	44	59	50	54	0.00	0.0	0	6,900	sw.	24	sw.	20	29	2	0	1.3	
San Francisco	153	161	167	29.78	29.94	.00	55.9	— 2.4	73	22	62	48	2	50	22	52	50	87	0.00	0.0	0	11,356	sw.	41	w.	30	16	11	4	3.6	
Point Reyes Light	.....	12	16	.....	.....	.....	52.6	— 1.2	73	22	58	45	18	48	27	....	....	....	0.00	— 0.3	0	15,325	nw.	48	nw.	9	5	2	24	8.0	
S. Pac. Coast Reg.							70.4	— 0.3										64	0.00	0.0										2.1	
Fresno	332	67	70	29.47	29.81	— .03	81.8	+ 0.3	111	19	101	56	13	63	43	59	40	30	0.00	0.0	0	4,709	nw.	19	nw.	11	31	0	0	0.4	
Los Angeles	330	74	82	29.53	29.88	— .03	69.6	+ 0.3	93	9	82	53	17	58	37	60	57	76	0.00	0.0	0	3,163	w.	16	w.	6	28	3	0	2.2	
San Diego	87	94	102	29.78	29.88	— .04	65.6	— 1.5	78	20	70	57	8	61	17	61	59	81	0.00	0.0	0	4,283	nw.	26	nw.	5	22	7	2	2.8	
San Luis Obispo	201	10	46	29.72	29.94	+ .01	64.4	— 0.3	92	9	78	46	31	51	44	55	50	69	0.00	0.0	0	3,422	n.	21	n.	8	24	7	0	3.1	
West Indies.																															
Basseterre	29	41	54	29.97	30.00	.....	80.6	.....	87	29	86	70	27	76	16	75	73	77	2.51	.....	19	8,586	e.	42	se.	27	3	20	8	6.2	
Bridgetown	30	57	65	29.92	29.94	.....	80.8	.....	88	23	86	73	9	75	15	76	74	80	2.96	.....	23	7,153	e.	28	e.	20	0	21	10	7.0	
Cienfuegos	52	62	67	29.94	29.99	.....	81.2	.....	93	4	90	69	21	72	22	75	73	80	3.62	.....	18	4,541	ne.	28	ne.	29	15	15	1	3.5	
Havana	57	83	100	29.94	30.00	.....	81.0	.....	91	19	88	69	24	74	19	75	73	79	3.87	.....	8	6,223	e.	40	e.	29	12	14	5	4.2	
Puerto Principe	358	55	62	29.62	29.96	.....	81.6	.....	97	30	92	68	21	71	27	74	72	82	1.66	.....	11	5,821	ne.	30	e.	6	7	15	9	5.7	
Kingston	286	38	52	29.66	29.96	.....	80.5	.... ..	94	3	89	70	22	72	21	73	71	74	2.03	.....	9	5,287	n.	29	se.	19	5	19	7	6.1	
Port of Spain	40	65	66	29.87	29.91	.....	80.3	.....	90	29	88	71	25	73	18	74	72	80	4.66	.....	18	3,292	e.	18	e.	6	7	15	9	5.7	
Roseau	25	37	47	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...	
San Juan	82	48	56	29.92	30.00	.....	79.7	. ....	87	2	85	70	8	74	16	75	73	80	7.53	+ 1.8	22	6,078	e.	19	e.	9	11	16	4	4.8	
Santiago de Cuba	82	45	51	29.87	29.95	.....	82.3	.....	94	4	90	71	20	74	20	74	71	73	1.34	.....	11	3,687	ne.	24	n.	20	5	23	3	5.4	
Santo Domingo	59	82	88	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...	
Willemstad	75	39	46	29.82	29.89	.. ....	82.2	.....	89	30	86	72	25	78	15	76	74	78	1.07	.....	6	9,491	e.	28	e.	7	9	16	6	5.0	

NOTE.—The data at stations having no departures are not used in computing the district averages. Letters of the alphabet denote miumber of days missing from the record. *Twoor more dates. †Received too late to be considered in departures, etc. ‡Station closed June 15, 1899.

TABLE II.—*Climatological record of voluntary and other cooperating observers, July, 1899.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Alco	94	58	78.8	11.59	
Ashville	100	55	79.3	8.27	
Bermuda	.....	58	.....	7.12	
Birmingham	99	62	80.9	7.61	
Bridgeport	.....	.....	.....	3.84	
Citronelle	94	68	81.1	7.85	
Clanton	95	59	79.4	6.59	
Daphne	97	67	81.7	8.30	
Decatur	103	60	81.3	5.31	
Demopolis	.....	.....	.....	4.67	
Eufaula *a*	101	62	81.7	9.15	
Evergreen	93	59	78.4	10.50	
Florence *a*	.....	.....	.....	3.32	
Florence *b*	100	59	81.0	3.65	
Fort Deposit	99	63	81.4	8.00	
Gadsden	101	52	78.6	5.90	
Goodwater	103	56	80.4	10.22	
Greensboro	98	63	80.4	4.43	
Hamilton	101	57	80.2	4.36	
Healing Springs	97	59	79.8	4.71	
Highland Home	94	67	79.6	7.94	
Jasper	100[d]	58	79.4	5.92	
Livingston *a*	100	63	81.7	6.02	
Lock No. 4	102	57	79.9	6.25	
Madison Station	101	60	80.1	4.75	
Maplegrove	101	55	79.0	7.48	
Marion	99	64	82.0	5.49	
Mount Willing	100	65	83.3	8.73	
Newbern	98	66	81.8	7.16	
Newburg	105	54	81.2	6.56	
Newton	100	59	79.4	5.70	
Oneonta	99	53	77.7	8.16	
Opelika	99	62	80.0	3.98	
Oxanna	101	57	78.4	8.81	
Pineapple	101	57	82.1	5.77	
Pushmataha	99	61	81.6	6.99	
Riverton	102[d]	56[d]	81.7[d]	3.05	
Rockmills	101	58	79.2	5.35	
Scottsboro	99	56	78.3	6.13	
Selma	102	61	82.5	6.95	
Talladega	101	56	79.9	7.17	
Tallassee	.....	.....	.....	6.82	
Thomasville	102	60	80.8	9.16	
Tuscaloosa	102	60	81.3	6.48	
Tuscumbia	98	61	81.3	3.84	
Union	101	60	82.5	5.81	
Union Springs	100	65	82.0	6.95	
Uniontown	98	67	82.6	6.33	
Valleyhead	98	54	77.8	5.06	
Warrior	.....	.....	.....	7.11	
Wetumpka	103	61	82.4	6.39	
Wilson *[1]	97	70	81.3	12.99	
Alaska.					
Juneau	86	48	61.6	1.06	
Kenai	82	31	54.2	1.36	
Killisnoo	71	44	56.6	0.90	
Sitka	87	42	56.6	2.27	
Arizona.					
Allaire Ranch	.....	.....	.....	2.65	
Arizona Canal Co. Dam	109	68	87.4	1.63	
Benson *[1]	99	74	84.8	1.00	
Bisbee	96	59	74.8	4.83	
Blaisdell *[1]	116	84	96.8	0.03	
Bowie *[1]	104	60	76.4	4.50	
Buckeye	108	68	88.4	T.	
Camp Creek	103	66	83.2	2.60	
Casa Grande *[1]	106	76	90.8	0.61	
Champie Camp	115	68	90.3	1.53	
Cochise *[1]	108	70	79.7	2.61	
Congress	105	67	85.8	0.80	
Dragoon	.....	.....	.....	4.86	
Dragoon Summit *[1]	97	58	77.0	3.32	
Dudleyville	105	64	84.8	1.13	
Fort Apache	97	40	70.7	4.55	
Fort Defiance	91	47	69.4	4.03	
Fort Grant	96	48	72.2	3.21	
Fort Huachuca	96	59	76.0	8.04	
Fort Mohave	122	70	96.6	T.	
Gilabend *[1]	116	78	90.1	1.60	
Holbrook	106	55	79.1	1.18	
Hot Springs	113	70	90.4	2.62	
Ingleside	113	70	92.0	1.24	
Jerome	99	61	79.9	1.90	
Lochiel *[1]	92	66	78.5	6.63	
Maricopa *[1]	112	82	96.3	0.71	
Mesa	111	68	88.8	1.35	
Mount Huachuca	101	56	75.6	5.63	
Music Mountain	110	61	88.6	0.89	
Natural Bridge	.....	.....	.....	4.70	
Oracle	97	60	77.6	3.23	
Oro	.....	.....	.....	4.51	
Oro Blanco	100	65	80.9	6.05	
Pantano *[1]	96	70	79.7	2.76	
Peoria	115	71[c]	92.3[d]	0.61	
Phenix	118	69	93.2	1.24	
Pima	105[d]	61	83.4[c]	1.34	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
Pinal Ranch	.....	.....	.....	6.00	
Prescott	97	46	73.0	3.03	
San Carlos	110	58	83.4	1.65	
San Simon *[1]	97	58	76.4	2.25	
Sentinel *[1]	115	81	97.2	0.75	
Signal	117	63	91.9	0.39	
Snowflake	96	51	73.6	1.96	
Strawberry	96	48	70.6	4.64	
Texas Hill *[1]	120	80	104.3	0.58	
Tombstone	98	60	77.3	3.50	
Tonto	.....	.....	.....	3.11	
Tuba	101	61	81.4	T.	
Tucson	107	68	86.6	1.87	
Vail *[5]	102	70	84.5	0.20	
Walnut Grove	.....	.....	.....	1.07	
White Hills	110	70	93.1	0.03	
Willcox	.....	.....	.....	2.30	
Winslow	98	50	75.6	T.	
Yarnell	.....	.....	.....	2.60	
Arkansas.					
Amity	95	56	78.9	1.75	
Arkansas City	.....	.....	.....	2.55	
Beebranch	97[c]	53[c]	79.0[c]	3.20	
Blanchard Springs	100	55	80.6	3.19	
Brinkley	95	58	78.8	9.44	
Camden *a*	.....	.....	.....	1.36	
Camden *b*	99	56	82.2	1.60	
Canton	.....	.....	.....	8.31	
Corning	96	53	77.8	3.36	
Dallas	98[c]	57[d]	80.7[c]	3.46	
Dardanelle	.....	.....	.....	3.90	
Elon	.....	.....	.....	1.79	
Fayetteville	91	57	76.5	7.40	
Forrest	95	58	76.7	5.71	
Fulton	.....	.....	.....	3.12	
Hardy	.....	57	.....	8.68	
Helena *a*	.....	.....	.....	6.28	
Helena *b*	98	62	81.0	6.07	
Hot Springs *a*	99	56	81.0	3.10	
Hot Springs *b*	.....	.....	.....	2.93	
Jonesboro	.....	58	.....	6.02	
Keesees Ferry	98	52	77.6	4.98	
Lacrosse	.....	.....	.....	6.34	
Lonoke	98	51	79.6	10.12	
Luna Landing *[5]	95	64	78.5	5.06	
Malvern	96	55	79.5	5.53	
Marianna	98	56	79.7	9.01	
Marvell	98	59	80.0	6.67	
Moore	.....	.....	.....	6.35	
Mossville	89	58	74.6	7.68	
Mount Nebo	90	57	75.7	6.20	
Nashville	98	54	80.2	3.06	
New Gascony	95	59	81.0	6.92	
Newport *a*	.....	.....	.....	5.72	
Newport *b*	97	58	79.2	5.66	
Newport *c*	97	56	79.1	5.60	
Oregon	94	53	77.3	6.82	
Osceola	100	57	80.0	5.80	
Ozark	97	63	81.3	5.87	
Pinebluff	98	59	81.1	4.12	
Pocahontas	95	56	77.0	6.61	
Pond	91	53	76.0	7.03	
Powell	.....	53	.....	6.88	
Prescott	100	56	82.4	2.99	
Rison	.....	56	.....	3.03	
Russellville	97	59	79.0	6.02	
Silver Springs	93	54	76.5	9.44	
Spielerville	96	55	79.7	5.47	
Stamps	98	.....	.....	2.24	
Stuttgart	97	56	79.8	6.96	
Texarkana	100	59	80.8	3.29	
Warren	100	57	81.6	0.97	
Washington	96	59	80.2	1.91	
Wiggs *[1]	100	58	81.8	2.04	
Winslow	.....	57	.....	7.28	
Witts Springs	93	52	75.7	5.64	
California.					
Arlington Heights	103	49	76.8	0.00	
Azusa	.....	.....	.....	0.00	
Ballast Point L. H	.....	.....	.....	0.00	
Bear Valley	.....	.....	.....	0.00	
Berkeley	79	49	60.2	0.00	
Bishop	102	47	74.1	0.00	
Blue Lakes City	112	45	75.4	0.00	
Boca *[1]	98	38	66.7	0.00	
Bodie	85	25	57.8	0.31	
Bowmans Dam	.....	.....	.....	0.00	
Cahto	.....	.....	.....	0.00	
Caliente *[1]	105	68	84.3	0.00	
Campbell	88	40	63.4	0.00	
Cape Mendocino L. H	.....	.....	.....	0.00	
Cedarville	95	40	69.4	0.68	
Centerville *[1]	90	56	68.1	T.	
Chico *[1]	107	60	84.6	0.00	
Claremont	97	46	71.8	0.00	
Corning *[1]	110	70	84.7	0.00	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Coronado	74	58	66.4	0.00	
Craftonville	102	54	79.2	0.00	
Crescent City	68	39	55.6	0.09	
Crescent City L. H	.....	.....	.....	0.07	
Cuyamaca	88	38	66.0	0.04	
Delano *[1]	107	70	85.0	0.00	
Delta *[1]	105	62	84.7	0.00	
Dewey	112	57	86.1	0.00	
Drytown	112	50	78.2	0.00	
Dunnigan *[1]	109	57	80.0	0.00	
Durham *[1]	106	58	78.6	0.00	
East Brother L. H	.....	.....	.....	0.00	
Edmanton *[1]	93	46	66.8	0.00	
El Cajon	99	45	71.4	0.00	
Elmwood	111	46	76.8	0.00	
Elsinore	110	46	77.1	0.00	
Escondido	102	43	70.5	0.00	
Fallbrook *[1]	101	55	69.6	0.00	
Folsom City *[1]	106	61	77.2	0.00	
Fordyce Dam	.....	.....	.....	0.00	
Fort Ross	73	43	56.2	0.00	
Georgetown	98	56	74.8	0.00	
Gilroy (near)	96	41	65.2	0.00	
Glendora	.....	.....	.....	0.00	
Goshen *[5]	109	68	86.9	0.00	
Grand Island *[5]	106	52	77.3	0.00	
Grass Valley	.....	.....	.....	0.00	
Greenville	98	32	64.2	0.00	
Hanford	110	53	80.2	0.00	
Healdsburg	100	36	67.4	0.00	
Hollister	96	39	64.2	0.00	
Humboldt L. H	.....	.....	.....	0.00	
Indio *[1]	112	80	93.2	0.00	
Iowa Hill *[1]	98	64	74.8	0.00	
Irvine	100	62	79.1	0.00	
Jackson	96	50	73.4	0.00	
Jolon	.....	.....	.....	0.00	
Keene	102	62	78.7	0.00	
Kennedy Gold Mine	104	50	74.4	0.00	
King City *[1]	96	46	58.4	0.00	
Kingsburg *[5]	110	74	90.1	0.00	
Kono Tayee	98	60	77.4	0.18	
Lagrange *[5]	112	57	83.2	0.00	
Lakeside	.....	.....	.....	0.00	
Lamesa	.....	.....	.....	T.	
Lankershim	113	54	80.2	0.00	
Laporte *[1]	88	49	62.0	0.00	
Las Fuentes Ranch	.....	.....	.....	0.00	
Legrand	112	49	79.6	0.00	
Lemoncove	113	54	83.0	0.00	
Lemoore *a* [1]	104	62	83.0	0.00	
Lick Observatory	91	56	71.6	0.00	
Lime Point L. H	.....	.....	.....	0.00	
Lodi	106	48	73.6	0.00	
Los Alamos	.....	.....	.....	0.00	
Los Gatos *b*	94	44	65.4	0.00	
Malakoff Mine	96	49	71.7	0.00	
Mammoth Tank *[1]	118	70	97.8	0.15	
Manzana	102	60	82.6	0.00	
Mare Island L. H	.....	.....	.....	0.00	
Merced *a* [1]	112	63	81.6	0.00	
Merced *b*	112	52	79.6	0.00	
Mills College	.....	.....	.....	0.00	
Milo	.....	.....	.....	0.00	
Milton (near) *[1]	106	55	76.6	0.00	
Modesto *[1]	107	60	79.0	0.00	
Mohave *[1]	106	70	85.7	0.00	
Mokelumne Hill *[3]	.....	55	73.0	0.00	
Monterio	104	60	83.7	0.00	
Monterey *[1]	77	51	61.4	0.00	
Morena Dam	100	46	74.6	0.00	
Mountain View	.....	.....	.....	0.00	
Mount Frazier	.....	.....	.....	0.00	
Napa *b*	100	44	66.6	0.00	
Needles	113	79	96.2	1.00	
Nevada City	94	43	67.6	0.00	
Newhall *[1]	106	62	77.5	0.00	
North Ontario	94	53	73.6	0.00	
North San Juan *[1]	99	54	71.9	0.00	
Oakland *a*	82	49	60.8	0.00	
Ogilby *[1]	118	80	98.8	0.00	
Oleta *[1]	101	56	72.9	0.00	
Orland *[1]	115	68	88.1	0.00	
Palermo	111	50	79.2	0.00	
Paso Robles *b*	102	45	70.2	0.00	
Peachland *[5]	88	51	65.7	T.	
Piedras Blancas L. H	.....	.....	.....	0.00	
Pilot Creek	.....	.....	.....	0.00	
Pine Crest	88	50	67.6	0.00	
Placerville	100	45	71.6	0.00	
Point Ano Nuevo L. H	.....	.....	.....	0.00	
Point Arena L. H	.....	.....	.....	0.00	
Point Bonita L. H	.....	.....	.....	0.00	
Point Conception L. H	.....	.....	.....	0.00	
Point Firmin L. H	.....	.....	.....	0.00	
Point George L. H	.....	.....	.....	0.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Point Hueneme L. H.	.....	.....	.....	0.00	
Point Lobos	65	48	54.7	0.00	
Point Loma L. H.	.....	.....	.....	0.00	
Point Montara L. H.	.....	.....	.....	0.00	
Point Pinos L. H.	.....	.....	.....	0.00	
Point Sur L. H.	.....	.....	.....	0.00	
Pomona (near)	102	51	75.3	0.00	
Poway *2	94	60	68.8	0.00	
Quincy	95	37	65.2	0.00	
Ranch House	96	60	76.0	0.00	
Raymond	115	40	82.0	0.00	
Redlands	104	52	77.6	0.00	
Represa	100	56	75.6	0.00	
Rio Vista	106	51	73.0	0.00	
Roe Island L. H.	.....	.....	.....	0.00	
Romie	94	40	64.2	0.00	
Rosewood	112	50	79.6	0.00	
Sacramento *a*	100	50	72.2	0.00	
Salinas *1	76	55	66.5	0.00	
Salton *1	120	90	102.1	0.00	
San Bernardino	106	47	75.3	0.00	
San Leandro *1	82	56	63.0	0.00	
San Luis L. H.	.....	.....	.....	0.00	
San Mateo *1	88	58	67.7	0.00	
San Miguel *1	107	53	75.9	0.00	
San Miguel Island	74	47	58.7	0.00	
Santa Barbara *a*	83	51	64.6	0.00	
Santa Barbara L. H.	.....	.....	.....	0.00	
Santa Clara *a*	.....	.....	.....	0.00	
Santa Cruz *b*	82	38	60.0	0.00	
Santa Cruz L. H.	.....	.....	.....	0.00	
Santa Maria	82	46	63.5	0.00	
Santa Monica *1	75	62	67.5	0.00	
Santa Paula	95	52	71.4	0.00	
Santa Rosa *1	89	45	63.9	0.00	
Shasta	111	57	83.0	0.00	
Sonoma	.....	.....	.....	0.00	
S. E. Farallone L. H.	.....	.....	.....	0.00	
Stanford University	89	44	63.5	0.00	
Stockton *a*	102	50	72.1	0.00	
Summerdale	91	50	68.6	0.00	
Susanville	93	43	67.4	0.00	
Tehama *1	110	74	84.0	0.00	
Tejon Ranch	106	66	84.2	0.00	
Templeton *1	112	50	69.2	0.00	
Thermalito	112	55	80.6	0.00	
Trinidad L. H.	.....	.....	.....	0.13	
Truckee *1	92	40	62.8	0.00	
Tulare *b*	.....	.....	.....	0.00	
Tulare *c*	114	54	83.0	0.00	
Ukiah	108	42	72.3	0.00	
Upperlake	106	45	74.8	0.00	
Upper Mattole *1	102	48	68.2	0.00	
Vacaville *a* *1	104	57	73.8	0.00	
Ventura	85	49	64.6	0.00	
Visalia *a*	98	66	78.8	0.00	
Visalia *b*	110	50	80.8	0.00	
Volcano Springs *1	123	90	101.1	0.04	
Walnut Creek	104	56	74.5	0.04	
West Palmdale	.....	.....	.....	T.	
Westpoint	.....	.....	.....	0.00	
West Saticoy	.....	.....	.....	0.00	
Wheatland	106	52	75.9	0.00	
Williams *1	106	64	84.8	0.00	
Wire Bridge *b	105	59	79.1	0.00	
Yerba Buena L. H.	.....	.....	.....	0.00	
Yreka	97	42	71.7	0.08	
Colorado.					
Antlers	96	45	71.8	2.25	
Arkins	.....	.....	.....	2.12	
Boulder	93	49	69.0	2.18	
Boxelder	.....	.....	.....	2.23	
Breckenridge	75	31	51.6	2.29	
Canyon	98	52	78.0	3.30	
Castlerock	92	45	67.8	4.48	
Cedaredge	96	44	70.6	0.57	
Cheyenne Wells	99	51	71.7	3.67	
Clearview *1	80	34	51.6	4.15	
Colorado Springs	90	46	66.5	2.57	
Cope	99	50	73.3	1.86	
Cripple Creek	84	42	62.5	3.92	
Crook	104	51	74.4	3.91	
Delta	102	46	74.0	0.85	
Dumont	.....	.....	.....	3.60	
Durango	93	47	69.7	1.91	
Fairview	87	40	60.8	4.06	
Fort Collins	94	45	67.0	4.95	
Fort Morgan	101	49	73.3	2.77	
Fox	.....	.....	.....	1.21	
Garnett	85	38	62.4	2.32	
Georgetown	83	42	62.3	.....	
Gilman	.....	.....	.....	2.11	
Gleneyrie	86	46	65.4	2.89	
Greeley	95	50	69.5	2.34	
Gunnison	87	36	62.4	1.69	
Hamps	96	42	68.8	2.50	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Colorado—Cont'd.	°	°	°	*Ins.*	*Ins.*
Hoehne	98	50	70.0	3.75	
Holly	.....	.....	.....	2.61	
Holyoke	.....	.....	.....	1.85	
Holyoke (near)	104	50	73.0	3.91	
Hugo	.....	.....	.....	5.20	
Lake Moraine	76	36	53.8	6.19	
Lamar	105	55	76.4	5.97	
Laporte	.....	.....	.....	2.62	
Las Animas	102	52	74.1	3.32	
Leadville (near) *1	78	43	53.7	2.21	
Leroy	100	48	70.9	2.17	
Longs Peak	78	36	54.8	4.32	
Mancos	92	45	67.9	0.93	
Meeker	98	37	66.3	1.10	
Minneapolis	98	53	74.6	3.15	
Moraine	84	36	58.2	3.02	
Pagoda	96	35	65.2	0.95	
Parachute	101	49	74.7	1.66	
Perry Park	.....	.....	.....	2.85	
Rockyford	102	53	72.5	7.00	
Ruby	.....	.....	.....	2.10	
Saguache	85	44	64.2	2.01	
Salida	91	41	65.6	3.41	
San Luis	88	39	62.6	2.66	
Santa Clara *1	86	47	62.5	7.06	
Seibert	.....	.....	.....	5.02	
Smoky Hill Mine	88	37	59.4	2.83	
Springfield	.....	.....	.....	2.33	
Strickler Tunnel	.....	.....	.....	5.37	
Trinidad	.....	.....	.....	3.44	
Troutvale	88 *e*	29 *e*	55.6 *e*	3.29	
T. S. Ranch	90	47	71.8	0.26	
Vilas	.....	.....	.....	4.21	
Wagon Wheel	.....	30	.....	3.34	
Walden	87	34	60.0	1.05	
Wallet	.....	.....	.....	3.83	
Westcliffe	85	39	60.4	2.59	
Wray	101	51	73.6	2.18	
Yuma	.....	.....	.....	2.63	
Connecticut.					
Bridgeport	92	47	72.2	4.73	
Canton	88	42	68.4	6.83	
Colchester	88	45	70.1	5.38	
Falls Village	.....	.....	.....	7.09	
Hartford *a*	88	51	72.0	7.82	
Hartford *b*	.....	.....	.....	7.20	
Hawleyville	90	48	70.6	4.91	
Middletown	91	45	71.6	5.87	
New London	89	53	69.4	5.29	
North Grosvenor Dale	90	46	70.5	5.62	
Norwalk	88	44	70.3	5.91	
Southington	86	45	70.0	5.62	
South Manchester	.....	.....	.....	4.73	
Storrs	86	46	68.7	5.55	
Voluntown	87	43	69.4	4.58	
Wallingford	.....	.....	.....	6.67	
Waterbury	91	43	71.3	6.02	
West Cornwall	85	48	68.4	6.70	
West Simsbury	.....	.....	.....	6.60	
Delaware.					
Milford	93	61	78.3	4.59	
Millsboro	93	52	76.4	6.56	
Newark	98	52	76.0	3.64	
Seaford	95	55	78.6	8.37	
District of Columbia.					
Distributing Reservoir *b*	92	65	78.5	3.63	
Receiving Reservoir *b*	89	62	77.6	6.76	
West Washington	95	52	76.8	6.48	
Florida.					
Archer	98	70	83.2	6.39	
Bartow	95	69	81.4	8.43	
Boca Raton	89	68	80.2	9.35	
Brooksville	90	70	81.4	11.15	
Carrabelle	95	70	81.4	6.00	
Clermont	100	69	84.2	6.63	
Dalkeith	99	67	82.8	.....	
De Funiak Springs	102	62	81.0	6.44	
Deland	95	69	79.8	.....	
Dry Tortugas	95	71	84.2	4.40	
Estero *1	96	72	79.3	14.93	
Eustis	95	69	81.0	13.55	
Federal Point	95	69	80.2	11.25	
Fort Meade	96	.....	.....	.....	
Gainesville	101	68	82.8	6.89	
Homeland	93	66	78.1	.....	
Huntington	96	68	80.2	11.63	
Inverness	93	69	80.0	10.08	
Jasper	97 *e*	67 *e*	80.7 *e*	.....	
Kissimmee	97	65	80.9	8.37	
Lake Butler	99	69	81.6	7.23	
Lake City	100	67	81.2	4.16	
Macclenny	100	66	81.8	7.00	
Manatee	93	68	78.8	24.45	
Merritts Island	92	72	81.6	8.14	
Myers	93	70	79.9	12.08	
New Smyrna	93	68	79.8	8.60	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Florida—Cont'd.	°	°	°	*Ins.*	*Ins.*
Ocala	99	69	81.6	6.49	
Orange City	.....	.....	.....	10.13	
Orlando	95	66	82.0	7.01	
Plant City	96	68	81.0	10.36	
St. Andrews	97	65	82.4	5.88	
St. Francis	95	68	79.8	12.97	
St. Francis Barracks	93	67	79.4	11.80	
Sebastian	90	71	80.6	5.51	
Stephensville *1	95	72	80.0	9.69	
Switzerland *1	95	67	79.2	12.86	
Tallahassee	96	68	81.2	3.21	
Tarpon Springs	94	69	79.6	18.46	
Wausau	100	61	82.4	3.69	
Georgia.					
Adairsville	100	56	78.4 *d*	5.22	
Alapaha	98	65	80.8	3.78	
Albany	106	67	84.2	3.38	
Allentown	104	62	84.2	3.50	
Americus	101	63	81.8	3.10	
Athens *b*	100	57	80.6	2.50	
Bainbridge	101	65	82.6	3.32	
Bellville	100	.....	.....	6.67	
Blakely	96	65	81.6	5.95	
Camak	102	56	82.0	1.88	
Carlton	.....	.....	.....	4.63	
Clayton	94	50	75.2	7.42	
Columbus	100	63	81.4	7.34	
Covington	103	57	81.8 *d*	2.66	
Crescent	.....	.....	.....	7.32	
Dahlonega	93	51	73.6	5.68	
Diamond	97	.....	.....	4.15	
Dublin	.....	.....	.....	3.91	
Eastman	100	63	81.8	4.72	
Elberton	99	61	80.6	3.35	
Fitzgerald	101	60	81.2	3.08	
Fleming	102	61	80.8	4.45	
Fort Gaines	101	62	81.4	6.93	
Franklin	96	60	79.0	5.33	
Gainesville	96	55	77.4	2.40	
Gillsville	99	52	78.4	2.92	
Greenbush	99	53	77.4	6.84	
Griffin	100	59	78.6	2.15	
Harrison	102	.....	.....	3.83	
Hawkinsville	102	60	79.6	4.95	
Hephzibah	.....	.....	.....	5.13	
Jesup	104	60	80.7	4.16	
Lagrange	100 *d*	57 *d*	77.3 *d*	5.40	
Leverett	104	53	81.5	1.84	
Louisville	103	64	82.0	5.09	
Lumpkin	99	66	81.6	5.48	
Marietta	94	54	76.8	8.35	
Marshallville	100	72	83.1	1.89	
Millen	104	57	82.1	3.35	
Morgan	102	61	83.5	7.57	
Newnan	101	59	79.7	3.45	
Oakdale	.....	.....	.....	5.03	
Point Peter	103	52	79.8	2.54	
Poulan	100	62	80.0	5.10	
Putnam	102	60	81.6	4.78	
Quitman	102	64	82.2	7.21	
Ramsey	100	55	78.0	5.44	
Rome	98	56	78.9	7.51	
Talbotton	103	55	81.5	2.08	
Tallapoosa	97	56	77.7	8.05	
Thomasville	99	66	82.2	7.74	
Toccoa	96	56	78.6	3.46	
Union Point	98	57	79.9	3.45	
Washington	100	63	81.6	4.16	
Way Cross	100	61	81.9	4.05	
Waynesboro	100	61	79.1	3.20	
Westpoint	101	63	81.0	5.42	
Idaho.					
American Falls	103	41	72.4	0.60	
Atlanta	91	32	63.0	0.02	
Blackfoot *f*	101	33	69.4	0.05	
Burnside	91	42	67.3	1.36	
Challis	101	41	69.7	0.36	
Chesterfield	92 *f*	28	62.0 *e*	0.40	
Downey	95	30	65.4	0.65	
Fort Sherman	101	37	66.2	1.40	
Gray	92	34	62.6	0.04	
Hagerman	111	45	77.8	0.05	
Idaho City	96 *h*	34 *h*	67.4 *h*	0.00	
Kootenai	100	45	69.7	0.35	
Lake	86	30	58.3	0.33	
Lakeview	91	42	64.3	T.	
Lewiston	104	52	75.4	0.06	
Lost River	95	37	66.9	0.69	
Marysville	97	25	63.4	0.75	
Moscow	93 *e*	41 *e*	65.4 *e*	0.47	
Murray	93	40	63.8	0.92	
Oakley	101	41	72.0	0.90	
Ola	103	40	72.4	0.10	
Paris	92	31	65.8	0.44	
Payette	104	46	74.6	0.11	
Pollock	106	42	71.0	0.19	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
Priest River	95	39	69.6	0.14	
St. Maries	97	42	65.5	0.58	
Salubria	103	36	71.4	0.01	
Soldier	97	29	64.4	0.37	
Swan Valley	94	26	64.4	0.69	
Weston	93	36	68.5	0.33	
Illinois.					
Albion	95	52	77.4	4.24	
Alexander	101	52	77.4	1.84	
Ashton	96	45	73.6	2.98	
Astoria	91	49	73.1	4.25	
Aurora *a*	95	48	74.0	4.82	
Aurora *b*	93	48	73.8	5.54	
Bloomington	98	52	76.0	1.92	
Bushnell	99	53	76.6	2.44	
Cambridge	93	56	74.4	2.91	
Carlinville	97	51	76.3	2.54	
Carlyle				3.09	
Charleston	94	54	76.6	0.71	
Chemung	91	40	70.7	4.95	
Chester				2.13	
Cisne	93	52	76.0	5.08	
Coatsburg	97	53	76.2	3.31	
Cobden	96	54	77.6	4.23	
Decatur	96	49	75.6	1.02	
Dixon	94	51	74.4	2.82	
Dwight *1	94	50	74.4	4.73	
Effingham	97	52	77.2	2.43	
Elgin	91	48	72.6	4.31	
Equality	100	54	75.8		
Flora	94	52	76.2	3.53	
Fort Sheridan	92	49	70.7		
Friendgrove *1	96	60	78.1	4.31	
Galva	96	49	74.8	2.82	
Glenwood				3.80	
Grafton				2.27	
Grayville	96	57	79.4	2.68	
Greenville	99	56	78.9	1.89	
Griggsville	97	55	76.4	3.16	
Halfway	96	56	78.8	4.46	
Halliday	96	52	76.6	3.45	
Havana	91	58	76.2	7.11	
Henry	93	47	74.0	4.57	
Hillsboro	97	53	76.2	2.18	
Joliet	93	50	73.6	5.26	
Kankakee	96	52	75.4	3.78	
Knoxville	96	42	73.4	2.71	
Lagrange	91	49	72.2	8.80	
Laharpe	96	48	73.8	2.58	
Lanark	93	40	72.0	3.66	
Loami				2.54	
McLeansboro	96	54	76.6	5.16	
Martinsville	94	51	76.5	4.51	
Martinton	96	46	73.7	2.55	
Mascoutah	96	51	77.0	1.94	
Mattoon	96	52	76.8	1.64	
Minonk	96	47	73.7	2.19	
Monmouth	98	47	74.8	1.49	
Monticello *b	94	58	77.2	1.25	
Morrisonville	94	52	74.8	0.72	
Mount Carmel				3.47	
Mount Pulaski	98	54	77.2	2.30	
Mount Vernon	96	52	75.4	4.98	
New Burnside	99	53	78.6	4.72	
Olney	96	52	77.1	2.82	
Oswego	94	50	74.3	4.83	
Ottawa	98	49	74.6	5.70	
Palestine	96	49	76.6	2.98	
Pana	97	51	76.8	1.44	
Paris	96[1]	52[1]	76.6[1]	3.99	
Peoria *a*				1.42	
Peoria *b*	97	52	76.6	1.69	
Philo	95	46	74.2	1.82	
Plumhill	92	55	75.8	6.12	
Rantoul	96	50	75.0	3.10	
Raum	96	59	79.5	4.19	
Riley	93	50	72.6	4.04	
Robinson	94	51	76.5	4.18	
Rockford	95	52	74.5	5.69	
Roundgrove	97	51	75.4	2.78	
St. Charles *1	90	56	72.8	6.00	
St. John	99	53	78.4	3.60	
Savanna	93	46	72.7	4.14	
Scales Mound	93	48	71.1	7.38	
Strawn				1.80	
Streator	94	47	73.1	5.22	
Sullivan	94	49	75.0	3.67	
Sycamore	90	48	72.0	4.04	
Tilden	94	52	75.9	5.79	
Tiskilwa	94	50	74.2	3.48	
Tuscola	96	50	75.8	3.71	
Walnut	94	47	74.5	5.05	
Wheaton *2		59	72.4	6.66	
Winchester	95	52	74.9	3.04	
Winnebago	96	46	71.4	6.18	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Indiana.	°	°	°	*Ins.*	*Ins.*
Anderson	93	47	74.0	4.35	
Angola	93	48	72.3	4.04	
Auburn	97°	44°	73.2°	4.73	
Bedford	96	49	77.4	0.98	
Bloomington	95	53	76.2	1.60	
Bluffton	97	44	74.2	4.61	
Booneville				4.10	
Bright	96	50	75.0	2.42	
Butlerville	95	46	74.9	3.52	
Cambridge City	97	45	73.6	2.53	
Columbia City *1	93	42	73.0	4.11	
Columbus	93	47	74.6	2.60	
Connersville	95	47	75.0	3.85	
Delphi	96	46	74.6	3.27	
Edwardsville *1	94	55	76.9	2.65	
Fairmount	101	43	75.0	3.42	
Farmland	94	45	73.0	5.06	
Fort Wayne	97	44	73.0	4.28	
Franklin *1	93	62	75.3	0.93	
Greencastle	93	53	75.6	3.78	
Greensburg	94	49	76.0	5.01	
Hammond	90	45	74.0	3.15	
Hector	96	42	74.7	3.09	
Huntington	94	48	74.2	3.81	
Jeffersonville	94	53	77.6	1.97	
Knightstown	96	45	74.7	4.45	
Kokomo	91	49	73.0	4.88	
Lafayette	94	49	74.9	4.35	
Laporte	99	49	75.0	3.35	
Logansport	96	49	75.6	1.51	
Madison	94	50	76.7	2.15	
Marengo	94	47	74.9	3.74	
Marion	98	46	74.2	3.51	
Markle	96	44	72.8	4.40	
Mauzy	97	45	74.1	3.18	
Michigan City *10	94	50	71.4		
Mount Vernon	97	53	77.6		
Northfield	93	46	72.8	3.55	
Paoli	95	47	76.9	3.72	
Peru	95	48	74.1	3.31	
Prairie Creek	98°	49°	77.0°	3.27	
Princeton	100	48	77.5	3.42	
Richmond	95	45	74.0	3.46	
Rockport	93	55	77.2	3.51	
Rockville	94	50	75.0	2.23	
Salem	94	42	73.7	3.20	
Scottsburg	94°	50°	77.2°	6.00	
Seymour	96	52	76.8	3.90	
Shelbyville	94	50	74.6	1.87	
South Bend	93	49	73.7	2.64	
Syracuse	92	45	72.5	4.32	
Terre Haute	95	55	77.8	1.56	
Topeka	90	45	71.4	4.21	
Valparaiso	92	52	72.2		
Vevay	97	53	79.4	0.55	
Vincennes	98	44	77.2	3.60	
Washington	97	53	77.8	3.82	
Winamac				3.15	
Worthington	97	47	76.5	1.98	
Indian Territory.					
Hartshorne	95	63	82.5	6.72	
Healdton	100	60	81.3	8.20	
Kemp	106	59	83.0	2.73	
Lehigh	99	64	81.4	3.60	
Muscogee	94	60	79.0	3.62	
Ryan	101	65	81.6	9.22	
Sapulpa	94	62	77.9	4.70	
South McAlester				8.88	
Tahlequah		61		13.15	
Tulsa				3.71	
Wagoner				10.08	
Webbers Falls				4.83	
Iowa.					
Afton	95	52	74.5	6.33	
Albia	92	47	73.0	5.29	
Algona *1	94	55	68.6	2.12	
Alta *a*	90	48	71.4	2.89	
Amana	92	48	73.9	5.78	
Ames *b*	92	51	73.2	1.60	
Ames (near)				1.01	
Atlantic	94	48	72.4	4.71	
Audubon	91	50	72.2	2.64	
Batavia				3.33	
Baxter	98	50	74.2	1.77	
Bedford	96	48	74.8	8.60	
Belknap	94	52	74.0	5.25	
Belleplaine	94	48	73.0	2.87	
Blockton	93	52	74.8	5.93	
Bonaparte	98	51	75.4	2.28	
Britt	93	43	70.8	2.58	
Burlington	97	48	76.0	2.60	
Bussey				7.42	
Carroll	93	45	71.4	1.40	
Carson				2.22	
Cedar Rapids	98	50	76.0	3.20	
Centerville	96	54	75.4	3.36	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Chariton	91	48	72.7	7.20	
Charles City	93	39	71.6	1.82	
Chillicothe				4.13	
Clarinda	96	51	74.9	5.39	
Clear Lake	98			1.42	
Clinton	94	46	73.3	3.54	
College Springs	95	54	75.3	5.96	
Coon Rapids	90	50	72.6	2.30	
Council Bluffs	95	54	75.2	2.21	
Cresco	90	41	70.1	3.47	
Cumberland				4.90	
Danville				2.34	
Decorah	93	42	70.7	1.57	
Delaware	91	47	71.9	2.12	
Denison	95	48	72.6	1.95	
Desoto	101°	50°	74.9°	4.48	
Diagonal	92	48	72.0	6.40	
Dows	91	47	71.2	1.44	
Eldon	100	52	75.8	3.62	
Elkader	98	42	73.2	2.02	
Emerson				2.40	
Fairfield	93	54	73.4	2.22	
Fayette	92	41	71.2	2.34	
Fonda	93	46	72.4	3.02	
Forest City	91	47	71.3	2.20	
Fort Madison				3.68	
Galva	93	49	71.6	1.39	
Gilman				2.30	
Gladbrook				1.90	
Glenwood	93	52	73.6	2.95	
Grand Meadow *1	88	54	69.9	2.24	
Greene	98	40	73.4	0.72	
Greenfield	94	52	73.2	4.73	
Grinnell (near)	90	54	73.0	2.84	
Griswold				5.23	
Grundy Center	93	43	71.0	1.69	
Guthrie Center	93	41	71.9	2.80	
Hamburg				3.77	
Hampton	95	49	72.7	2.79	
Harlan	94	50	72.6	2.31	
Hawkeye				4.38	
Hedrick	93	50	73.4	3.03	
Hopeville	90	54	72.8	4.37	
Humboldt	92	46	72.4	2.02	
Independence	91	46	71.1	1.16	
Indianola	91	52	73.7	7.34	
Iowa City	93	48	73.6	3.78	
Iowa Falls	95	41	72.4	1.43	
Keosauqua	97	54	76.1	4.53	
Knoxville	91	52	74.2	5.81	
Lacona				4.51	
Lamoni	93	50	73.2	5.03	
Lansing	94	43	73.2	1.11	
Larrabee	91	48	71.8	2.71	
Leclaire				3.06	
Lemars	91	49	71.6	3.22	
Lenox	91	55	72.6	8.66	
Logan	95	47	73.6	1.83	
Maple Valley				2.15	
Maquoketa	96	45	72.3	2.77	
Marshall	95	46	73.6	1.00	
Mason City	92[4]	38[4]	70.8[4]	2.25	
Melrose				5.70	
Monticello	93	48	72.9	2.48	
Mooar	96	50	72.8	4.23	
Mountayr	91	55	73.6	6.25	
Mount Pleasant	97	50	75.6	1.07	
Mount Vernon *a* *1	94	60	75.0	5.49	
Mount Vernon *b*	95	50	75.2	5.51	
Murray				4.71	
New Hampton	91	46	71.2	3.32	
Newton	93	50	73.6	2.30	
Northboro				5.33	
North McGregor				1.44	
Northwood	93	43	71.0	3.18	
Odebolt	97	48	73.7	1.11	
Ogden	92	51	72.0	2.17	
Olin	91	46	72.4	3.34	
Onawa	92	53	73.8	1.29	
Osage	92	42	70.8	2.06	
Osceola	91	52	73.0	4.80	
Oskaloosa	93	47	73.6	3.06	
Ottumwa	96	52	75.0	4.73	
Ovid	93	50	73.6	4.72	
Pacific Junction	92	50	72.4	3.16	
Pella	89	49	71.0	7.18	
Plover	96	45	72.6	1.82	
Primghar	95	47	75.4	2.85	
Redoak	95	54	75.4	4.01	
Ridgeway	93	50	72.7	2.82	
Rockwell City	93	52	72.7	2.32	
Ruthven	94	46	72.8	3.88	
Sac City	91	51	72.1	1.27	
Scranton	93	54	73.6	1.58	
Sheldon	92	45	70.3	3.20	
Sibley	93	45	69.8	4.20	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Sigourney	99	45	75.1	2.70	
Sioux Center	97[h]	51[h]	75.9[h]	2.20	
Spencer	93[e]	45[e]	70.6[e]	2.88	
Spirit Lake	95	49	70.9	6.91	
Storm Lake	88	51	71.1	0.62	
Stuart	97	54	75.9	3.75	
Tara	99	.....	.....	2.00	
Thurman	93	51	73.7	2.72	
Toledo	95	43	73.2	2.87	
Villisca	96	52	74.1	3.18	
Vinton *1	90[c]	53	72.9[c]	1.94	
Wapello	100	50	75.0	1.78	
Washington	93	48	71.6	2.82	
Washta	.....	.....	.....	1.69	
Waterloo	94	45	72.8	1.61	
Waverly	91	45	72.3	1.35	
Westbend *1	92	55	71.5	3.02	
Westbranch	91	45	72.0	3.75	
Westunion	.....	.....	.....	2.95	
Whitten *1	96	56	72.8	0.42	
Wilton Junction	94	46	74.4	3.24	
Winterset	92	51	73.2	6.12	
Woodburn	.....	.....	.....	4.97	
Kansas.					
Abilene	98	56	76.6	4.88	
Achilles	.....	.....	.....	2.52	
Altoona *3	96	62	76.0	4.77	
Anthony	.....	.....	.....	2.19	
Atchison *a*	94	58	75.5	7.53	
Atchison *b* *1	93	63	76.2	6.85	
Augusta	96	56	77.1	4.36	
Baker	97	55	76.5	6.97	
Burlington	94	56	76.2	9.06	
Campbell	101	55	77.3	5.22	
Centropolis *1	100	59	78.5	5.80	
Chanute	94	57	78.2	10.05	
Colby	100	52	74.0	4.41	
Columbus	95	59	78.0	9.42	
Coolidge	102	54	75.0	4.04	
Cunningham	102	58	77.2	2.11	
Dresden	96	55	73.8	5.46	
Ellinwood	97	56	74.6	4.30	
Englewood	102	61	78.0	7.12	
Eskridge	96	58	77.0	7.62	
Eureka	.....	.....	.....	7.74	
Eureka Ranch	98	53	75.0	5.44	
Fallriver	95	58	77.6	6.42	
Fanning	95	45	73.8	5.25	
Fort Riley	95	.....	.....	.....	
Fort Scott	98	58	78.4	4.39	
Frankfort	97	54	74.8	5.29	
Garden City	101	57	76.2	6.21	
Garfield	.....	.....	.....	6.01	
Gibson	97	53	73.6	5.05	
Gove *1	95	60	76.0	6.83	
Grenola	96	58	77.4	7.41	
Hays	96	51	73.6	5.15	
Horton	94	57	75.3	8.94	
Hutchinson	95	59	76.5	4.40	
Independence	97	62	79.5	11.44	
Lakin	100[k]	55	76.0[e]	4.20	
Lawrence	91	58	75.5	7.08	
Lebanon	97[e]	47[e]	75.2[e]	3.60	
Lebo	93	59	75.8	7.66	
Macksville	97	58	75.1	5.51	
McPherson	100	54	75.7	3.58	
Manhattan *b*	98	57	76.2	6.66	
Manhattan *c*	97	50	76.0	6.28	
Meade	95	55	75.1	10.15	
Medicine Lodge	101	60	79.3	1.21	
Minneapolis	101	51	77.2	2.21	
Morantown	91	57	75.4	9.15	
Mounthope *1	95	61	77.4	5.84	
Ness City	102	57	77.3	5.92	
Newton	101	58	77.4	5.78	
Norwich	99	61	78.3	2.11	
Oberlin	.....	.....	.....	3.61	
Olathe	94	56	76.2	8.13	
Osage City	93	57	75.6	9.60	
Oswego	96	61	79.8	6.01	
Ottawa	94	55	75.7	8.50	
Paola	94	55	75.3	4.89	
Phillipsburg	100	52	76.6	2.88	
Pratt	100	61	76.7	3.00	
Rome *1	98	62	77.0	1.45	
Russell	100	54	75.9	4.25	
Salina	96	54	75.9	3.55	
Scott	98	49	74.1	6.60	
Sedan	95	60	78.4	4.80	
Seneca	95	53	73.4	6.81	
Toronto	94	56	76.3	10.15	
Tribune	98[k]	53[k]	72.2[k]	4.09	
Ulysses	106	58	76.4	6.30	
Valley Falls	94	56	75.4	6.07	
Viroqua	98	57	76.4	5.99	
Wallace	.....	.....	.....	6.08	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wamego *1	94	58	75.6	7.92	
Winfield	101	61	79.8	3.45	
Winona	.....	.....	.....	9.75	
Yates Center	.....	54	.....	11.21	
Kentucky.					
Alpha *2	.....	56	74.8	4.43	
Bardstown	100	52	77.7	5.65	
Blandville	93	58	77.2	6.54	
Bowling Green *b*	99	58	79.7	5.26	
Burnside	.....	.....	.....	5.25	
Caddo	.....	.....	.....	2.50	
Canton *1	98	57	78.5	4.10	
Carrollton	96	59	80.4	1.62	
Catlettsburg	96	51	76.4	3.87	
Earlington	99	48	77.2	5.66	
Edmonton	94	54	76.0	5.45	
Ensor	95	54	77.1	3.22	
Eubank	99	50	74.6	4.48	
Falmouth	.....	.....	.....	1.59	
Fords Ferry	97	55	76.8	2.51	
Frankfort	97	54	78.8	1.23	
Georgetown	99	52	78.5	.....	
Greensburg	99	49	76.3	3.16	
Henderson	95	55	77.6	4.47	
Hopkinsville	99	54	78.0	7.12	
Irvington	95	50	76.3	3.31	
Jackstown	96	48	75.8	2.75	
Leitchfield	97	51	76.4	3.32	
Loretto	98	47	75.4	3.10	
Marrowbone	99	51	76.8	6.31	
Maysville	99	50	77.6	2.47	
Middlesboro	98	51	74.9	3.47	
Mount Hermon	97	53	76.6	7.08	
Mount Sterling	96	51	77.1	4.26	
Owensboro	96	51	77.2	1.80	
Owenton	95	61	79.0	2.39	
Paducah *a*	.....	.....	.....	5.19	
Paducah *b*	100	60	80.3	6.52	
Princeton	100	51	79.2	3.28	
Richmond	98	50	76.8	2.55	
Russellville	96	55	78.0	7.41	
St. John	96	49	75.2	2.45	
Scott	94	52	75.7	3.43	
Shelby City	99	48	76.4	3.86	
Shelbyville	100	49	78.2	2.07	
Vanceburg	.....	.....	.....	2.40	
Williamsburg	100	58	79.4	4.46	
Louisiana.					
Abbeville	96	68	81.6	4.70	
Alexandria	101	64	83.0	2.14	
Amite	100	67	83.0	3.55	
Bastrop	100	58	83.2	4.59	
Baton Rouge	98	69	82.4	2.19	
Calhoun	101	54	81.2	1.58	
Cheneyville	100	60	82.2	1.05	
Clinton	98	66	81.6	0.70	
Como	.....	.....	.....	2.75	
Covington	97	68	82.4	5.58	
Donaldsonville	96	68	81.2	3.85	
Emilie	95	67	81.0	2.98	
Farmerville	97	60	82.0	1.40	
Franklin	97	69	82.8	5.81	
Grand Coteau	103	66	83.4	1.05	
Hammond	100	67	82.6	3.96	
Houma	95	69	82.9	3.17	
Jeanerette	103	65	81.9	.....	
Jennings	100	66	82.3	2.96	
Lafayette	103	66	82.0	2.63	
Lake Charles	100	68	83.2	4.68	
Lake Providence	97[k]	64	82.4[e]	7.14	
L'Argent	96	67	81.8	4.56	
Lawrence	98	70	84.6	5.86	
Liberty Hill	105	63	84.2	3.45	
Mansfield	101	58	81.6	2.80	
Melville	98[j]	68[j]	83.4[j]	2.55	
Minden	100	55	82.6	0.37	
Monroe	99	59	81.8	2.97	
Montgomery	100	61	83.6	1.34	
New Iberia	96	67	81.8	2.92	
Oakridge	100	60	83.2	5.10	
Opelousas	102	65	82.2	2.90	
Paincourtville	98	.....	.....	3.53	
Plain Dealing	103	55	81.1	2.53	
Plaquemine	99	60	78.6	3.23	
Prevost	99	69	83.8	6.63	
Rayne	101	67	82.5	3.77	
Robeline	101	57	81.8	1.05	
Ruston	99	59[h]	81.0[d]	5.04	
Schriever	99	68	82.5	5.83	
Shellbeach	98	66	81.4	3.76	
Southern University	95	66	79.8	3.98	
Sugar Ex. Station	95	70	83.1	7.30	
Sugartown	98	67	83.7	3.44	
Venice	98	72	81.8	2.86	
Wallace	98	61	82.2	3.26	
White Sulphur Springs	100	67	84.8	5.07	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Maine.	°	°	°	*Ins.*	*Ins.*
Bar Harbor	88	44	65.6	6.55	
Belfast *6	83	55	68.2	4.73	
Calais	91	40	64.6	4.23	
Cornish *1	93	50	68.4	5.87	
Cumberland Mills	98	42	70.2	4.70	
Fairfield	90	44	67.2	5.13	
Farmington	96	34	67.6	5.07	
Gardiner	97	46	70.4	5.48	
Kineo	85	50	67.5	7.37	
Lewiston	98	47	70.4	4.43	
Mayfield	90	42	65.6	4.79	
North Bridgton	96	44	68.4	5.35	
Orono	91	41	68.2	4.49	
Petit Menan *1	76	54	62.2	.....	
Rumford Falls	96	41	67.8	4.71	
Winslow	94	39	67.3	6.81	
Maryland.					
Annapolis	95	60	77.8	4.66	
Bachmans Valley	94	47	74.0	2.92	
Berlin	95	59	77.6	5.05	
Boettcherville	100	47	75.3	1.62	
Boonsboro *a*	100	52	77.3	2.23	
Cambridge	95[f]	59[f]	79.2[f]	7.15	
Chase	98	46	74.7	3.04	
Chestertown	91	54	76.2	4.53	
Chewsville	96	50	74.6	1.10	
Clear Spring	97	54	74.1	2.41	
Coleman	98	54	77.4	3.77	
Collegepark	95	56	76.6	5.90	
Cumberland	95	61	79.5	1.66	
Darlington	94	54	75.2	2.71	
Deerpark	90	37	66.8	2.08	
Easton	93	52	76.8	6.11	
Ellicott City	93	52	74.0	2.22	
Fallston	90	57	74.2	2.02	
Frederick	95	53	76.8	3.21	
Frostburg	93	49	72.0	2.04	
Grantsville	92	41	68.3	3.15	
Greatfalls	93	51	75.4	3.31	
Greenspring Furnace	98	51	75.3	1.31	
Hancock	100	50	76.2	1.86	
Harney	.....	.....	.....	4.59	
Jewell	91	56	75.5	5.79	
Johns Hopkins Hospital	96	55	76.7	1.85	
Laurel	97	53	76.4	4.72	
McDonogh	94	60	75.8	5.65	
Mount St. Marys Coll.	96	58[d]	75.9	1.95	
New Market	96	53	76.4	3.76	
Pokomoke City	93	55	77.8	5.43	
Princess Anne	90	50	75.4	6.26	
Rockhall *a*	94	53	77.4	3.43	
Rockhall *b*	92	51	75.4	3.52	
Sharpsburg	96	54	75.8	2.93	
Smithsburg *a*	96	52	75.4	0.92	
Smithsburg *b*	98	54	75.6	1.03	
Solomons	93	61	79.0	4.13	
Sunnyside	89	39	67.1	3.58	
Takoma Park	95	51	76.7	5.80	
Taneytown	.....	52	.....	2.01	
Van Bibber	93	58	76.2	2.54	
Westernport	91	50	73.8	2.74	
Woodstock	95	54	75.8	2.68	
Massachusetts.					
Adams	92	45	68.1	.....	
Amherst	89	43	69.4	5.02	
Bedford	90	49	70.0	3.35	
Bluehill (summit)	91	52	70.2	4.21	
Cambridge	94	48	72.7	2.49	
Chestnut Hill	95	48	72.4	3.70	
Cohasset	.....	.....	.....	3.67	
Concord	94	44	69.8	3.36	
East Templeton *1	90	56	70.5	4.54	
Fallriver	87	56	71.7	2.82	
Fitchburg *a* *1	90	57	70.3	4.47	
Fitchburg *b*	92	47	70.2	4.23	
Framingham	93	45	71.6	3.16	
Groton	90	44	69.3	2.89	
Hyannis *1	82	53	69.3	3.52	
Jefferson	.....	.....	.....	4.82	
Lawrence	92	50	71.9	4.46	
Leeds	93	42	69.5	7.01	
Leicister Hill	90	46	68.6	3.49	
Leominster	.....	.....	.....	3.61	
Long Plain	.....	.....	.....	3.27	
Lowell *a*	94	49	72.6	4.13	
Lowell *b*	93	47	71.3	.....	
Middleboro	88	42	69.4	2.99	
Monson	89	42	70.2	5.92	
New Bedford *a*	85	53	69.4	3.97	
New Bedford *b*	87	48	70.1	3.58	
New Salem	88	48	68.4	4.15	
Pittsfield	87	44	68.4	8.84	
Plymouth *1	86	57	70.4	3.06	
Princeton	.....	.....	.....	3.70	
Provincetown	85	57	70.6	4.23	
Salem	.....	.....	.....	1.97	

TABLE II.—*Climatological record of voluntary and other cooperating observers.*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Massachusetts—Cont'd.	°	°	°	*Ins.*	*Ins.*
Somerset [1]	92	52	73.9	3.05	
South Clinton	.....	.....	.....	3.33	
Springfield Armory	92	48	72.4	5.37	
Sterling	.....	.....	.....	3.43	
Taunton *c*	88	43	69.5	4.44	
Webster	.....	.....	.....	4.11	
Westboro	93	46	72.1	2.50	
Weston	90	44	70.2	2.98	
Williamstown	87	44	68.0	5.08	
Winchendon	.....	.....	.....	5.93	
Worcester *b*	93	51	72.6	3.57	
Michigan.					
Adrian	95	47	71.4	6.09	
Agricultural College	96	43	69.8	2.11	
Allegan [2]	85	45	71.6	.....	
Alma	93	46	69.6	6.95	
Ann Arbor	96	49	71.9	1.92	
Arbela	93	40	67.0	5.12	
Badaxe	88	49	67.6	4.44	
Baldwin	94	39	68.3	8.48	
Ball Mountain	93	48	70.0	2.45	
Baraga	93	.....	.....	1.59	
Battlecreek	100	47	73.5	2.12	
Bay City	89	50	68.4	7.04	
Berlin	93	43	67.8	2.98	
Berrien Springs	97	45	72.0	3.63	
Big Point Sable [10]	84	52	64.8	.....	
Big Rapids	93	43	67.6	10.62	
Birmingham	95	45	71.3	2.25	
Boon	91	38	64.2	5.04	
Calumet	86	46	64.4	2.76	
Carsonville	92	44	67.6	3.15	
Charlevoix	91	48	66.4	4.71	
Cheboygan	90	48	66.0	2.71	
Clinton	98	47	72.6	2.91	
Coldwater	94	46	71.5	3.28	
Eagle Harbor	85	43	61.0	2.57	
East Tawas	86	42	66.4	5.92	
Eloise	94	50	72.8	2.74	
Ewen	95	40	65.9	2.00	
Fairview	91	49	71.8	2.17	
Fitchburg	94	41	70.3	2.77	
Flint	94	43°	69.7°	3.95	
Frankfort	90	50	70.6	....	
Gladwin	91	39	67.5	8.55	
Grand Rapids	97	48	72.5	3.96	
Grape	95	49	73.4	2.18	
Grayling	93	36	66.4	5.05	
Hanover	96	44	72.0	2.80	
Harbor Beach	89	45	65.6	2.05	
Harrison	91	35	64.8	5.21	
Harrisville	88	46	64.2	6.87	
Hart	95	50	70.0	5.41	
Hastings	97	43	70.8	2.74	
Hayes	89	49	67.8	3.73	
Highland Station	.....	.....	.....	1.89	
Hillsdale	94	44	71.2	3.81	
Holland [10]	92	54	70.0	.....	
Howell	90	40	69.0	.....	
Humboldt	90	32[1]	61.4	2.86	
Ionia	96	45	71.2	2.21	
Iron Mountain	89	42	67.0	2.80	
Jackson	98	48	73.3	2.17	
Jeddo	91	47	67.5	3.18	
Kalamazoo	98	43	71.8	3.22	
Lake City	94	42	66.6	6.05	
Lansing	95	48	70.6	2.62	
Lapeer	93	41	69.2	3.17	
Ludington	88	40	64.2	4.45	
Luzerne	90	36	64.9	5.81	
Mackinaw	84	49	65.2	2.44	
Madison	94	49	72.8	2.52	
Mancelona	93	41	66.6	1.80	
Manistee	89	40	65.9	4.41	
Manistique	85	45	63.7	1.13	
Menominee	90	50	68.8	5.36	
Middle Island [10]	80	55	64.8	.....	
Mottville	97	42	72.6	3.69	
Mount Clemens	95	48	72.0	3.50	
Mount Pleasant	95	44	69.6	6.59	
Muskegon	93	49	69.6	3.00	
Newberry	.....	.....	.....	6.80	
North Manitou Island [10]	90	45	64.9	.....	
North Marshall	93	46	71.1	2.60	
Northport	87	50	66.2	1.23	
Old Mission	91	46	67.8	2.18	
Olivet	91	50	71.2	3.14	
Omer	88	38	61.6	4.00	
Ovid	93	45	69.1	4.62	
Owosso	97	45	71.5	5.22	
Plymouth	95	40	69.6	2.37	
Port Austin	89	45	66.9	3.75	
Powers	90	32	65.6	.....	
Reed City	94	42	68.8	8.86	
Rockland	90[1]	30[4]	61.0[4]	3.90	
Rogers	89	32	63.6	2.15	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Saginaw	96	47	69.6	5.35	
St. Ignace	85	48	63.8	1.47	
St. Johns	94	49	70.6	5.63	
St. Joseph	92	50	72.6	2.93	
Sidnaw	96	38	65.5	1.45	
Somerset	92	46	70.7	3.39	
South Haven	95	49	69.4	2.90	
Stanton	96	45	69.0	5.52	
Thomaston	100	.....	.....	3.50	
Thornville	90	50	70.3	2.67	
Thunder Bay Island [10]	80	56	65.1	.....	
Traverse City	96	47	69.7	4.35	
Vandalia	96	47	72.6	2.46	
Vassar	93	43	69.0	4.11	
Vermilion Point [10]	86	44	59.2	.....	
Wasepi	93	44	71.6	2.87	
Waverly	98	.....	.....	1.73	
West Harrisville	85	43	64.7	6.25	
Wetmore	91	45	63.8	1.38	
White Cloud	95	41	68.2	4.55	
Ypsilanti	90	50	70.6	2.97	
Minnesota.					
Ada	94	42	69.0	2.49	
Albert Lea	93	46	72.2	3.96	
Alexandria	89	43	69.8	2.32	
Ashby	94	41	71.0	1.66	
Beardsley	100	38	70.2	2.13	
Bermidji	93	42	69.6	3.58	
Bird Island	97	44	72.4	1.86	
Blooming Prairie	91	42	70.3	4.10	
Brainerd	95°	42°	72.0°	2.13	
Caledonia	89	45	69.8	3.32	
Camden	95	48	71.5	2.09	
Campbell	97	37	71.2	0.67	
Collegeville	91	50	72.4	2.26	
Crookston	93	43	67.8	4.30	
Deephaven	.....	.....	.....	1.17	
Detroit City	91	39	67.4	2.54	
Faribault	91	44	70.6	2.47	
Farmington	95	49	71.4	1.38	
Fergus Falls	93	42	70.5	1.89	
Grand Meadow	96	44	71.6	5.36	
Granite Falls [2]	91	45	69.1	0.35	
Hallock	91	40	67.0	3.35	
Lake City	94	42	71.8	1.45	
Lake Jennie	95	44	73.6	1.50	
Lakeside	93	45	71.6	0.88	
Lake Winnibigoshish [1]	89	58°	67.1	5.29	
Leech Lake	92	43	69.0	4.53	
Leroy	92	41	70.8	4.41	
Long Prairie	90	37	69.4	2.51	
Luverne	89	46	70.4	4.52	
Lynd	94°	45°	70.4°	1.06	
Mapleplain [1]	92	45°	71.5	1.17	
Milaca	100	39	71.3	2.43	
Milan	95	42	70.9	3.14	
Minneapolis *a*	95	45	72.3	2.13	
Minneapolis *b* [1]	92°	42	71.6	1.55	
Minnesota City [2]	94	56	73.1	1.49	
Montevideo	98	46	72.6	.....	
Morris	95	46	71.8	1.11	
Mount Iron	88	36	65.4	5.14	
Newfolden	91	42	67.9	9.63	
New London	96	44	71.6	1.05	
New Richland [2]	93	54	71.4	.....	
New Ulm	97	45	75.5	0.47	
Park Rapids	92	41	66.4	3.42	
Pine River	91	48	68.2	2.97	
Pipestone	89	46	69.3	2.48	
Pleasant Mounds	89	48	69.7	2.46	
Pokegama Falls	90	37	66.0	3.70	
Redwing	.....	.....	.....	1.93	
Reeds	.....	.....	.....	2.55	
Rolling Green	89	49	70.9	2.48	
Roseau	93	36	66.8	6.60	
St. Charles	91	45	71.2	1.52	
St. Cloud	90	46	70.8	4.51	
St. Peter	87	44	70.2	1.21	
Sandy Lake Dam	90	43	67.4	3.20	
Shakopee	91	49	73.7	1.89	
Tower	88	36	63.2	6.30	
Two Harbors	89	45	61.8	4.94	
Wabasha [2]	97	50	71.7	1.81	
Willmar	91	45	70.8	1.78	
Willow River	.....	37	.....	1.21	
Winnebago City	93	49	71.7	4.25	
Worthington	89	40	69.8	3.55	
Zumbrota [1]	93°	41	71.6	.....	
Mississippi.					
Aberdeen	103	60	80.8	5.10	
Agricultural College	97	63	81.8	4.56	
Americus	98	65	81.6	9.36	
Austin	94	57	78.9	8.40	
Batesville	97	57	79.6	10.49	
Bay St. Louis	90	69	82.6	4.51	
Biloxi	94	65	78.5	5.99	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Mississippi—Cont'd.	°	°	°	*Ins.*	*Ins.*
Booneville	99	62	79.8	3.20	
Briers	....	67	.....	1.72	
Brookhaven	102	63	83.2	7.20	
Canton	98	60	80.6	2.46	
Columbus *a*	.....	.....	.....	5.54	
Columbus *b*	100	62	81.3	5.27	
Corinth	97	61	80.4	1.91	
Crystal Springs	100	65	82.4	5.44	
Edwards	99	64	83.3	5.96	
Fayette	.....	64	.....	2.80	
Fayette (near) [1]	98	71	83.8	.....	
Greenville *a*	96	65	81.8	2.11	
Greenville *b*	97	66	82.4	2.10	
Greenwood	95	61	80.2	7.16	
Hattiesburg	97	68	83.0	3.05	
Hazlehurst	97	65	80.6	5.58	
Hernando	98	60	80.6	5.15	
Holly Springs	96	62	80.4	3.99	
Jackson	98	67	82.0	2.68	
Kosciusko	100	.....	.....	6.70	
Lake	97	59	77.6	8.95	
Leakesville	100	63	81.4	7.60	
Logtown	95	63	80.8	5.57	
Louisville	96	58	78.8	3.46	
Macon	102	61	82.4	3.64	
Magnolia	99	67	82.4	2.35	
Natchez	98	66	83.4	2.50	
Okolona	102	61	83.4	4.88	
Palo Alto	98	63	81.6	5.20	
Pontotoc	96	58	79.4	7.89	
Port Gibson	99	62	82.4	2.35	
Rosedale [b]	99	60	79.8	3.36	
Stonington [1]	94	70	81.6	.....	
Thornton	....	.....	.....	5.40	
Tupelo	.....	.....	.....	5.01	
University	96	53	79.8	5.79	
Walnut Grove	.....	.....	.....	5.09	
Water Valley [1]	97	60	79.2	7.86	
Waynesboro	98	62	80.4	4.80	
Westpoint	103	61	83.3	.....	
Windham	100	61	81.2	4.92	
Woodville	100	65	82.7	1.94	
Yazoo City	102	61	83.4	5.00	
Missouri.					
Appleton City	101	58	79.0	7.19	
Arthur [2]	.....	62	76.2	5.83	
Avalon	92	54	74.4	5.46	
Bethany	99	49	74.6	5.08	
Birchtree	96	51	73.2	2.89	
Boonville	.....	.....	.....	5.10	
Brunswick	90	56	74.7	5.80	
Carrollton	91	60	76.4	5.21	
Conception	91	58	75.3	9.39	
Cook Station	100	45	75.2	4.45	
Cowgill [2]	94	56	76.6	6.43	
Darksville	93	56	75.4	4.04	
East Lynne [2]	.....	58	72.2	5.98	
Edgehill [2]	96	58	76.8	3.33	
Eightmile [1]	91	58	73.9	7.07	
Eldon	96	51	75.2	3.26	
Elmira	93	52	74.4	5.45	
Fairport	.....	.....	.....	4.02	
Fayette	94	55	75.0	5.02	
Fulton	.....	.....	.....	5.18	
Galena	.....	.....	.....	6.84	
Gallatin [1]	96	57	75.8	4.24	
Gayoso	98	54	79.6	4.67	
Glasgow	93	55	75.2	5.59	
Gorin	.....	.....	.....	3.93	
Halfway	95	55	75.6	3.03	
Harrisonville	93	55	75.4	4.93	
Hazlehurst	.....	.....	.....	5.87	
Hermann	.....	.....	.....	1.96	
Houston	97	49	75.6	2.90	
Houstonia (near)	.....	.....	.....	3.61	
Irena	.....	.....	.....	6.58	
Ironton	98	47	75.4	5.28	
Jackson [2]	90	63	76.3	3.62	
Jefferson City	99	51	77.4	2.82	
Kidder	94	55	74.4	3.47	
Lamar	95	58	78.0	6.38	
Lamonte	.....	.....	.....	3.52	
Lebanon	95	57	76.6	2.26	
Lexington	94	55	76.0	6.21	
Liberty	92	54	75.3	5.05	
Louisiana	94	50	75.4	4.20	
McCune [1]	94	60	75.2	2.74	
Marblehill	95	49	75.2	7.19	
Marshall	92	55	74.8	3.43	
Maryville	98	54	74.3	6.29	
Mexico	98	50	76.8	3.30	
Miami [2]	93	60	77.4	4.52	
Mineralspring	92	44	74.2	.42	
Montreal	95	51	74.6	3.61	
Mount Vernon	98	56	77.8	4.15	
Neosho	93	53	76.1	6.28	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Nevada	91	57	75.8	3.85	
New Haven	97	56	77.4	4.72	
New Madrid	98	60	81.0	6.63	
New Palestine	96	54	75.6	3.16	
Oakfield	96	58	76.6	5.84	
Olden	93	52	74.0	2.99	
Oregon *a*	94	57	75.4	8.65	
Oregon *b*	97	58	77.2	8.84	
Palmyra *[5]	94	60	77.2	4.12	
Phillipsburg *[1]	99	64	76.3	1.74	
Pickering *[2]		49	70.7	7.35	
Poplarbluff	96	59	78.8	7.28	
Potosi	97	43	73.2	4.49	
Princeton	102	51	78.2	3.76	
Rhineland	98	51	76.7	3.14	
Richmond	91	57	75.2	4.40	
Rolla				2.72	
St. Charles	95	60	78.2	2.31	
St. Joseph				5.36	
Sarcoxie *[2]	100	66	76.4	3.47	
Sedalia	97	54	75.9	2.11	
Seymour	93	53	74.4	2.98	
Shelbina				6.90	
Sikeston	96	55	77.2	4.73	
Steffenville	93°	55°	75.3°	5.65	
Stellada	95	48	75.9	4.72	
Sublett	97	50	75.9	5.23	
Trenton	91	55	74.4	3.95	
Unionville	100	55	78.6	2.55	
Vichy	102	59	79.4	3.15	
Warrensburg	95	55	77.2	2.17	
Warrenton	97	54	77.0	2.99	
Wheatland				4.14	
Willow Springs	96	50	75.8	4.01	
Wylie	94	56	77.3	7.63	
Zeltonia	99	49	76.2	2.08	
Montana.					
Adel	91	28	58.6	1.27	
Billings	102	44	71.5	T.	
Boulder	95	39	63.6	0.80	
Butte	88	42	65.6	0.90	
Canyon Ferry	96	47	69.5	1.74	
Chinook	100	40	68.2	1.84	
Columbia Falls	94	38	65.4	1.86	
Corvallis	98			0.02	
Crow Agency	96	42	69.2	1.93	
Dearborn Canyon	91	40[4]	67.5	1.99	
Deer Lodge	97	32	64.6		
Dell	93	32	62.2	0.03	
Fort Benton	101	47	68.2	1.30	
Fort Keogh	102	42	71.4	2.20	
Fort Logan	92	33	63.2	T.	
Glendive	103	42	72.0	5.42	
Glenwood	94	36	64.5	0.26	
Greatfalls	96	46	68.4	1.70	
Kipp	99	34	63.8	2.08	
Manhattan *	93	36	65.7	0.02	
Martinsdale	95	39	66.4	2.03	
Marysville	92	38	64.8	0.37	
Missoula	100	42	69.4	1.05	
Ovando	97	34	64.2	1.37	
Parrot	95	44	66.4	0.33	
Plains	97	44	67.2	0.09	
Poplar	101	46	71.5	1.24	
Ridge	96	35	67.0	1.68	
St. Pauls	94	42	66.2	1.70	
Troy	98	37	64.0	0.37	
Utica	102	40	64.8	2.57	
Wibaux	95	35	68.3	2.15	
Yale	95	38	66.4	1.44	
Nebraska.					
Agee *[1]	100	55	72.5	4.34	
Albion	91	48	70.3	2.17	
Alliance				1.85	
Alma *[1]	96	54	73.9	2.79	
Ansley	95	48	71.4	4.86	
Arapaho *[1]	100	58	76.5	1.10	
Arborville *[1]	97	56	72.9	3.03	
Ashland *a*	95	53	74.8	3.54	
Ashland *b* *[1]	101	64	77.8	3.37	
Ashton				3.10	
Auburn	96	50	75.6	5.63	
Aurora *[1]	95	61	75.4		
Bartley				1.91	
Bassett				3.67	
Beatrice	95	51	74.6	4.91	
Beaver City	104	49	75.9	3.94	
Bellevue				3.04	
Benedict				3.98	
Benkleman				2.42	
Blair	98	55	72.8	2.54	
Bluehill				2.98	
Bradshaw				3.28	
Brokenbow				6.42	
Burchard				4.69	
Burwell				1.27	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Callaway	98	44	72.0	1.40	
Camp Clarke	106	48	75.8	2.26	
Central City				3.44	
Chester				6.13	
Clatonia	94	54	75.6	3.77	
Cody				0.04	
Columbus	91	51	72.5	4.11	
Creighton	95	45	72.9	2.55	
Crete	92	54	73.5	3.71	
Culbertson				3.95	
Curtis *a*	99°	53°	73.8°	5.70	
David City	92	57	74.6	4.50	
Dawson	99	44	75.7	8.15	
Eden				7.68	
Edgar *a*				2.10	
Elba				2.87	
Ericson *[1]	101	58	75.2	1.70	
Ewing				1.08	
Fairbury	96	50	75.0	5.16	
Fairfield	97	53	74.4	2.45	
Fairmont	100	54	73.8	3.33	
Fort Robinson	102	48	72.0	0.97	
Franklin	98°	50°	75.4°	3.70	
Fremont	90	52	72.0	2.95	
Geneva	96	52	74.7	2.61	
Genoa	97	55	74.2	1.71	
Gering	104	49	72.8	1.90	
Gordon				1.50	
Gothenburg	97	52	71.9	1.80	
Grand Island *a*				1.61	
Grand Island *b*	98	54	74.2	2.48	
Grand Island *c*	98	49	74.0	1.48	
Greeley				2.85	
Haigler				2.87	
Hartington	93	49	72.0	1.66	
Harvard	93	53	72.8	4.30	
Hastings *[1]	95	56	73.0	2.20	
Hayes Center				3.36	
Hay Springs	100	47	72.0	1.60	
Hebron	93	52	73.2	5.60	
Hickman				1.90	
Holdrege *b*				3.60	
Hooper *[1]	90	58	72.3	2.52	
Hubbard				1.29	
Imperial	106	46	73.7	3.12	
Johnstown				0.25	
Kearney				4.90	
Kennedy	105	36	72.2	3.18	
Kimball	91	48	69.1	2.70	
Kirkwood *[1]	101	53	73.4	4.10	
Lexington	96	48	71.0	4.06	
Lincoln *b*	93	54	74.5	1.47	
Lincoln *d*	95	52	75.6	1.46	
Lodgepole	102	48	70.8	2.65	
Loup *[1]	100	56	71.2	3.36	
Lynch	100	46	73.4	3.37	
Lyons				2.37	
McCook				3.01	
McCool				3.03	
Madison	92	54	71.4	3.01	
Madrid *[5]	106	55	77.8	2.95	
Marquette				2.99	
Merriman				0.55	
Minden *a*	94	53	72.4	3.39	
Minden *b*				3.28	
Monroe				1.61	
Nebraska City *b*				2.95	
Nebraska City *c*	92	53	74.4	2.97	
Nemaha *[1]	99	61	76.0	5.48	
Nesbit	105	48	71.8	3.42	
Norfolk *b*	94	50	72.7	2.16	
North Loup				1.18	
Oakdale	95	50	72.4	1.35	
Odell *[5]	96	56	79.6	4.70	
O'Neill	98	49	71.5	4.48	
Ord				0.84	
Osceola				6.35	
Ough				2.50	
Palmer *b*				2.79	
Palmyra				1.82	
Paxton				2.81	
Plattsmouth *a*				2.69	
Plattsmouth *b*				1.98	
Pleasant Hill				3.80	
Ravenna *a*	95	53	71.8	2.11	
Redcloud *a*				4.62	
Redcloud *b* *[1]	95	62	74.9	5.01	
Republican *[1]	98	60	75.8	3.03	
Rulo				6.31	
St. Libory				2.35	
St. Paul				4.73	
Salem *[1]	96	68	76.6	10.25	
Sargent				3.59	
Schuyler				2.50	
Seneca *[1]	96	50	72.8	0.28	
Seward *[1]	91	65	74.8	4.09	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Spragg				1.98	
Springview	105	48	76.0	2.61	
Stanton *[1]	92	58	72.2	3.25	
State Farm	97	48	74.4	1.94	
Strang				2.45	
Stratton				2.64	
Superior *[5]	100	64	79.0	5.20	
Syracuse				1.81	
Tablerock				6.06	
Tecumseh *b*	98	51	75.5	5.15	
Tecumseh *c*				5.97	
Tekamah	92	52	73.2	3.21	
Thedford				3.32	
Turlington	99	54	74.8	1.85	
Valentine	104	48	73.6	1.34	
Valparaiso				2.61	
Wakefield	93	46	72.4	0.83	
Wallace				2.95	
Wauneta				3.11	
Weeping Water *[1]	93	49	73.3	2.61	
Wellfleet				4.11	
Westpoint	96	50	74.0	3.58	
Whitman				0.15	
Wilber *[1]	94	54	72.0	3.89	
Willard				1.88	
Wilsonville *[1]	98	56	76.5	6.10	
Wisner				2.75	
Wymore *[1]	98	58	76.9	4.92	
York *[1]	97	60	74.4	5.35	
Nevada.					
Battle Mountain *[1]	99	53	78.0	T.	
Beowawe *[1]	100	60	77.2	T.	
Candelaria	98	54	76.0	T.	
Carlin *[1]	98	48	71.4	0.15	
Carson City	96	39	67.4	T.	
Clover Valley				0.48	
Cranes Ranch				0.04	
Elko (near)	100	34	66.6		
Ely	96	45	70.3	0.61	
Empire Ranch	102	48	77.1	0.05	
Fenelon *[1]	87	40	64.2	0.10	
Golconda *[1]	100	49	69.3	0.08	
Halleck *[1]	106	52	71.5	T.	
Hawthorne *b*	99	53	75.6	0.02	
Hot Springs				0.06	
Humboldt *[1]	95	60	74.2	T.	
Lee				0.10	
Lewers Ranch	96	42	68.4	0.01	
Los Vegas	95	59	77.5	T.	
Lovelocks *[1]	100	60	76.6	0.00	
Martins	92	40	65.8	0.00	
Mill City *[1]	110	50	74.9	0.05	
Monitor Mill	94	46	70.4	0.58	
Palisade *[1]	101	60	75.8	0.11	
Palmetto	96	42	69.0	0.01	
Reno State University	98	42	69.6	0.22	
Sodaville	103	54	80.2	0.07	
Tecoma *[1]	100	58	73.2	T.	
Toano *[1]	98	56	71.1	0.40	
Tuscarora	90	43	68.0	0.33	
Tybo	97	52	73.4	0.07	
Verdi *[1]	104	55	73.2	0.00	
Wadsworth *[1]	106	40	71.8	0.10	
Wells	99	40	68.2	0.37	
New Hampshire.					
Alstead *[6]	90	49	72.2	5.30	
Berlin Mills	96	35	66.0	5.43	
Bethlehem	89	42	66.4	5.49	
Brookline *[1]	92	42	71.8	5.36	
Claremont	101	38	70.8	3.79	
Concord	97	39	69.6	4.35	
Durham	96	45	69.4	3.99	
Grafton	95	33	66.2	7.25	
Hanover	95	39	67.8	4.49	
Keene	93	37	68.4	5.28	
Littleton	92	39	66.1	4.94	
Nashua	95	43	71.5	3.01	
Newton	93	41	69.2	3.82	
North Conway	96	40	68.2	4.25	
Peterboro	91	37	67.8	4.40	
Plymouth	94	36	68.4	3.44	
Sanbornton	92	40	67.1	5.94	
Stratford	94	35	66.6	4.10	
Warner				8.40	
New Jersey.					
Asbury Park	91	54	72.2	4.71	
Bayonne	95	52	76.0	6.46	
Belvidere	92	44	70.8	4.42	
Bergen Point	91	54	74.5	6.99	
Beverly	98	50	76.2	6.56	
Billingsport *[1]	94	66	77.0	6.37	
Boonton	91	44	71.0	6.39	
Bridgeton	98	52	77.8	9.02	
Camden	94	53	74.8	4.89	
Cape May C. H.	94	51	76.0	4.60	
Charlotteburg	91	38	70.6	5.98	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New Jersey—Cont'd.	°	°	°	*Ins.*	*Ins.*
Chester	93	46	71.4	4.80	
Clayton	95	48	75.4	6.61	
College Farm	95	51	74.9	6.32	
Deckertown	92	44	71.4	6.30	
Dover	98	44	73.3	5.25	
Egg Harbor City	95	47	74.6	5.75	
Elizabeth	96	50	75.6	6.72	
Englewood	94	50	74.1	6.27	
Flemington	98	47	74.1	4.11	
Freehold	91	53	73.2	6.27	
Friesburg	95	51	76.1	7.29	
Hammonton	.....	.....	.....	6.80	
Hanover	91	46	72.8	5.24	
Hightstown	94	53	75.5	5.17	
Imlaystown	98	53	77.0	4.44	
Lebanon	.....	.....	.....	3.97	
Moorestown	95	50	75.0	5.69	
Mount Pleasant	.....	.....	.....	7.70	
Newark	94	49	73.8	4.85	
New Brunswick	96	50	76.0	6.54	
Newton	95	45	72.1	8.43	
Ocean City	90	54	70.4	5.83	
Oceanic	88	55	73.4	5.89	
Paterson	97	51	74.9	6.05	
Perth Amboy	95	55	76.1	5.76	
Plainfield	95	46	74.0	6.65	
Rancocas	.....	.....	.....	5.87	
Rivervale	92	44	71.3	3.61	
Rocktown	.....	.....	.....	3.18	
Roseland	93	44	72.0	5.53	
Salem	98	52	76.8	6.34	
Somerville	95	47	75.1	4.71	
South Orange	92	49	73.7	3.70	
Staffordville	.....	.....	.....	6.08	
Toms River	95	45	74.3	5.52	
Trenton	96	54	77.6	4.31	
Tuckerton	91	48	74.3	6.47	
Vineland	98	52	76.4	7.31	
Woodbine	92	50	74.2	4.08	
New Mexico.					
Albert	101	58	78.4	5.66	
Albuquerque	104	58	76.6	.....	
Alma	96	48	74.2	5.24	
Aztec	95	.....	.....	1.26	
Bell Ranch	.....	.....	.....	3.81	
Bernalillo	96	54	77.0	3.21	
Bluewater	92	45	69.6	4.45	
Cambray	.....	.....	.....	1.90	
Clayton	92	54	71.5	10.51	
Deming	.....	.....	.....	3.92	
East Lasvegas	92	51	70.8	7.09	
Eddy	106	60	80.6	1.00	
Engle	96	60	76 2	3.67	
Espanola	93	52	72.2	1.66	
Folsom	93	40	68.8	5.34	
Fort Bayard	93	54	72.4	4.66	
Fort Union	90	47	68.4	3.98	
Fort Wingate	92	47	70.2	3.25	
Gage	.....	.....	.....	3.40	
Galisteo	97	54	72.2	4.64	
Gallinas Spring	101	45	74.0	6.16	
Gila	99	59	78.6	5.15	
Hillsboro	96	58	78.2	2.22	
Las Vegas Hotsprings	91	40	68.1	4.72	
Lordsburg	.....	.....	.....	2.62	
Los Lunas	97	53	75.0	2.75	
Lower Penasco	92	53	71.8	5.89	
Mesilla Park	101	55	76.6	4.54	
Monero	95	40	65.6	2.97	
Raton	88	49	68.7	7.47	
Rincon	100	58	79.2	1.06	
Roswell	100	59	76.7	4.37	
San Marcial	98	54	77.2	2.24	
Socorro	100	59	77.1	3.18	
Strauss	.....	.....	.....	3.22	
White Oaks	92	50	71.7	5.53	
Winsors Ranch	84	29	59.2	5.19	
New York.					
Adams	.....	.....	.....	3.39	
Addison	92	43	70.2	3.31	
Akron	.....	.....	....	2.73	
Alfred	90	.....	.....	1.70	
Angelica	92	40	68.8	2.56	
Appleton	94	53	70.4	2.36	
Arcade	92	42	68.2	2.90	
Atlanta	.....	.....	.....	2.10	
Auburn	95	49	71.8	3.91	
Avon	96	47	71.7	2.26	
Axton	88	36	66.4	3.43	
Baldwinsville	95	49	71.8	2.33	
Bedford	88	44	69.8	6.65	
Bolivar	92	35	66.9	4.30	
Bouckville	91	44	68.2	2.86	
Boyds Corners	.....	.....	.....	5.99	
Brentwood	90	45	71.6	5.90	
Caldwell	90	45	70.2	2.72	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Canajoharie	91	42	68.9	4.01	
Canton	89	42	68.4	3.57	
Carmel	89	50	71.6	5.28	
Carvers Falls	94	40	69.4	3.77	
Catskill	91	49	72.0	3.75	
Cedarhill	101	45	74.3	3.66	
Charlotte[10]	91	52	70.6	.....	
Chenango Forks	.....	.....	.....	2.70	
Cherry Creek	.....	.....	.....	3.57	
Cooperstown	89	45	68.0	3.92	
Cortland	93	40	69.6	4.69	
Cutchogue	88	50	71.7	5.74	
DeKalb Junction	.....	.....	.....	2.74	
Dryden	97	40	69.0	4.03	
Easton	.....	.....	.....	3.70	
Ellenburg Depot[1]	84°	52°	65.6°	3.50	
Elmira	93	50	72.8	2.69	
Fayetteville	.....	.....	.....	3.66	
Fleming	93	50	71.2	4.48	
Fort Niagara	92	50	67.7	2.93	
Franklinville	91	37	67.4	3.16	
Fulton	.....	.....	.....	1.52	
Garrattsville	89	41	67.0	5.48	
Glens Falls	95	46	71.8	2.86	
Gloversville	94	40	69.1	4.09	
Greenwich	94	44	71.2	2.30	
Haskinville	.....	.....	.....	3.70	
Hemlock Lake	93	51	71.3	4.36	
Honeymead Brook	90	48	70.6	9.44	
Hopewell	89	41	70.9	4.34	
Humphrey	89	48	69.0	4.15	
Ithaca	96	46	70.8	3.46	
Jamestown	89	48	69.6	4.48	
Keene Valley	90	36	66.4	3.91	
King Station	.....	.....	.....	4.74	
Lake Hill	88	40	66.8	6.19	
Liberty	85	50	67.4	7.57	
Little Falls	92	46	69.2	2.48	
Lockport	91	52	69.7	1.27	
Lowville	92	42	67.6	3.05	
Lyndonville	.....	.....	.....	2.29	
Lyons	93	53	71.0	4.20	
Madison Barracks	92	46	68.4	0.70	
Mayle	.....	.....	.....	3.22	
Middletown	90	51	71.2	8.29	
Mohonk Lake[11]	84	55	70.0	6.32	
Mount Morris	98	47	72.1	3.07	
Newark Valley	.....	.....	.....	1.69	
New Lisbon	89	35	65.6	3.19	
North Germantown	92	50	72.1	5.19	
North Hammond	94	52	70.0	2.46	
North Lake	88	41	65.0	6.13	
Number Four	87	38	64.2	3.34	
Nunda	98	47	72.4	2.05	
Ogdensburg	88	48	68.0	3.11	
Oneonta	96	39	68.7	4.05	
Oxford	94	39	69.3	5.22	
Penn Yan	99	48	72.8	3.44	
Perry City	98	42	69.2	4.30	
Phenix	.....	.....	.....	2.09	
Pine City	.....	.....	.....	2.37	
Plattsburg Barracks	96	35	64.2	3.51	
Port Byron	92	46	70.0	2.87	
Port Jervis	91	45	71.5	10.49	
Poughkeepsie	93	42	71.6	5.56	
Primrose	92	53	72.4	6.29	
Ridgeway	93	53	70.9	2.80	
Rome	92	45	68.4	2.85	
Romulus	95	50	71.6	2.95	
Rose	.....	.....	.....	3.93	
St. Johnsville	96	42	70.7	4.31	
Salisbury Mills	.....	.....	.....	3.76	
Saranac Lake	90	35	66.1	2.50	
Saratoga Springs	92	45	69.8	3.65	
Schenectady	98	49	73.4	5.02	
Scottsville	.....	.....	.....	3.54	
Setauket	88	52	72.2	3.10	
Sherwood	.....	.....	.....	2.47	
Skaneateles	.....	.....	.....	3.17	
South Canisteo	94	40	67.7	2.99	
Southeast Reservoir	.....	.....	.....	6.17	
South Kortright	91	36	68.2	4.31	
Straits Corners	96	39	69.2	4.05	
Volusia	88	46	67.6	4.95	
Wappingers Falls	92	46	73.0	5.05	
Warwick	.....	.....	.....	6.10	
Watertown	94	49	70.4	2.16	
Waverly	95	40	70.7	4.08	
Wedgwood	95	49	70.8	3.77	
West Berne	94	59	74.5	2.20	
West Chazy	97	43	68.0	.....	
Westfield *a*	91	50	70.8	2.80	
Westfield *b*	91	.....	.....	3.50	
Westfield *c*	90	54	71.7	1.53	
Westpoint	92	47	71.3	5.78	
Willetspoint	91	53	73.0	4.75	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Williamson	.....	.....	.....	4.38	
North Carolina.					
Abshers	96	44	76.6	3.99	
Asheville	.....	.....	.....	3.35	
Biltmore	94	45	72.8	4.97	
Bryson City	.....	.....	.....	4.57	
Chapel Hill	96[b]	52	78.6[d]	4.95	
Currituck Inlet	...	.....	.....	6.56	
Edenton	95	55	78.2	5.98	
Experimental Farm	95	58	77.8	9.62	
Fairbluff	.....	.....	.....	8.37	
Fayetteville	95	54	77.3	8.35	
Flatrock	92	44	71.4	3.54	
Goldsboro	95	54	77.8	9.45	
Greensboro	96	54	76.8	5.77	
Greenville	95	53	78.0	10.23	
Henderson	94	55	77.0	8.39	
Hendersonville	95	47	72.4	4.07	
Horse Cove	91	51	73.1	4.76	
Lenoir[1]	93	54	75.6	3.00	
Linville	84	40	65.4	3.39	
Littleton	97	52	78.0	5.92	
Louisburg	98	52	77.9	8.39	
Lumberton	97	57	79.2	9.08	
Mana	.....	.....	.....	8.86	
Marion	99	51	76.2	2.12	
Marshall	92	49	73.8	3.30	
Mocksville	98	52	77.2	2.99	
Moncure	98	52	77.4	8.76	
Monroe	101	47	77.6	4.59	
Morganton	98	50	76.2	4.23	
Mountairy	97°	49°	74.0°	3.72	
Mount Pleasant	102	54	78.4	2.74	
Murphy	.....	.....	.....	4.51	
Newbern	95	59	78.3	7.84	
Oakridge	97	48	76.6	4.45	
Pantego	.....	.....	.....	8.94	
Patterson[1]	94	50	71.1	2.95	
Pittsboro	97	50	76.8	7.79	
Rockingham	102	55	79.3	4.04	
Roxboro	95	52	75.0	6.22	
Salem	96	49	77.2	6.73	
Salisbury	102	54	79.2	7.87	
Saxon	100	52	76.0	4 41	
Selma	99	49	77.9	12.15	
Settle	98	47	77.0	3.09	
Sloan	96	55	78.2	11.16	
Soapstone Mount	98	52	76.5	3.57	
Southern Pines *a*	99	52	79.1	10.65	
Southern Pines *b*	97	52	78.5	9.07	
Southport	89	63	79.7	7.47	
Springhope[1]	92	54	75.6	9.08	
Tarboro	100	48	78.9	8.93	
Waynesville	92	45	69.6	2.66	
Weldon *a*	95	53	77.6	10.30	
Weldon *b*	.....	.....	.....	10.27	
North Dakota					
Amenia	100	41	69.0	2.01	
Ashley	99	36	68.0	1.95	
Berlin[1]	98°	36	64.0	2 21	
Buxton	90	40	66.3	2.24	
Churchs Ferry	102	37	68.3	1.80	
Coal Harbor	96[b]	40[b]	69.4[b]	3.60	
Devils Lake	94	40	68.0	2.28	
Dickinson	97	38	68.7	2.79	
Donnybrook	96	.....	.....	3.40	
Dunseith	.....	32	.....	3.38	
Ellendale	100	38	71.1	2.18	
Fargo	94	40	68.4	2.78	
Forman	99	40	71.7	1.81	
Fort Berthold	94	47	71.2	4.04	
Fort Yates	106	38	71.0	1.17	
Fullerton[1]	100°	34	67.3	1.00	
Gallatin	100	35	68 1	1.14	
Grafton	91	44	66.3	2.04	
Hamilton	96	37	67.0	3.48	
Jamestown	101	38	68.7	0.97	
Kelso	.....	.....	.....	3.81	
Langdon	89	44	65.4	3.65	
Larimore	96	41	67.5	3.04	
Lisbon	101	38	69.8	0.86	
Mayville	96	44	69.8	4.32	
Medora	104	36	69.9	1.38	
Melville	98	45	68.8	2.78	
Milton	88	39	65.2	3.30	
Minnewaukon	94	40	67.8	2.17	
Minot	93	41	69.9	2.30	
Minto	97	38	68.1	2.23	
Napoleon	102	36	68.9	0.83	
Pembina	95	40	69.0	4.40	
Portal	94	38	65.7	0.97	
Power	95	37	67.3	2.34	
Sheyenne	.....	.....	.....	6.12[d]	
Steele	109	37	69.4	1.61	
Towner	93	36	67.6	2.43	
University	89	44	67.4	.....	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
North Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wahpeton	99	40	70.8	1.28	
Willow City	100	33	67.4	1.00	
Woodbridge	96	37	65.8	1.01	
Ohio.					
Akron	94	46	72.8	3.57	
Ashland	95	48	73.6	3.92	
Ashtabula	90	50	70.6	2.75	
Atwater	.....	.....	.....	3.33	
Bangorville	94	48	72.8	5.45	
Bellefontaine	95	51	74.8	5.46	
Bement	.....	.....	.....	5.21	
Benton Ridge	99	46	73.8	4.21	
Bethany	100	48	76.9	4.32	
Bigprairie	92	51	73.6	3.79	
Binola	.....	.....	.....	4.65	
Bladensburg	92	45	72.0	4.63	
Bloomingburg	95	52	75.6	5.84	
Bowling Green	95	47	72.4	4.33	
Bucyrus	96	46	73.8	5.01	
Cambridge	98	44	71.8	4.66	
Camp Dennison	97	52	76.6	3.47	
Canal Dover	97	45	73.9	3.53	
Canton	95	49	73.7	4.69	
Carrolton	95	46	73.2	4.15	
Cedarville	.....	.....	.....	6.51	
Celina	96	44	71.8	4.06	
Chillicothe	95	50	75.8	3.87	
Circleville	94	51	75.2	3.88	
Clarksville	93	50	75.2	6.02	
Cleveland *a*	91	54	71.7	5.46	
Cleveland *b*	98	54	72.3	4.70	
Coalton	95	44	74.7	3.30	
Colebrook	93	43	70.2	3.53	
Dayton *a*	99	48	76.0	4.10	
Dayton *b*	.....	.....	.....	4.56	
Defiance	95	46	73.1	4.22	
Delaware	97	44	74.1	5.45	
Demos	92	52	73.1	3.70	
Dupont	93	46	72.2	4.05	
Elyria	97	47	73.0	4.82	
Findlay	98	49	47.7	5.08	
Frankfort	92	46	73.4	4.50	
Garrettsville	95	43	70.6	2.66	
Granville	94	.....	.....	5.47	
Gratiot	92	49	73.0	3.64	
Greenfield	94	55	76.4	4.10	
Greenhill	94	43	70.6	5.19	
Greenspring	95	60	78.2	4.41	
Greenville	90	49	72.9	2.70	
Hackney	96	49	75.2	6.78	
Hanging Rock	96	51	77.8	2.87	
Hillhouse	96	45	70.8	3.64	
Hillsboro	92	48	74.2	2.73	
Hiram	93	53	72.3	2.19	
Hudson	97	46	72.4	4.20	
Jacksonboro	97	53	76.8	3.95	
Kenton	99	49	75.7	3.28	
Killbuck	93	49	72.6	3.20	
Lancaster	93	45	73.3	5.19	
Leipsic	99	.....	.....	.....	
Levering	92	45	71.6	6.45	
Logan	99	50	76.0	3.58	
Lordstown	94	43	70.6	3.17	
Lowell	99	47	76.6	.....	
McArthur	94	44	73.7	3.28	
McConnelsville	93	49	74.7	5.60	
Mansfield	.....	.....	.....	4.75	
Marietta	92	54	74.0	5.36	
Marion	98	49	75.3	4.73	
Medina	99	47	73.0	2.51	
Milfordton	96	46	72.4	3.87	
Milligan	96	45	74.0	4.83	
Millport	92	44	71.0	5.26	
Montpelier	95	46	72.3	3.95	
Napoleon	94	45	70.6	5.19	
Neapolis	.....	.....	.....	5.50	
New Alexandria	91	51	73.2	4.20	
New Berlin	95	47	73.0	3.45	
New Holland	95	51	75.4	3.07	
New Paris	94	48	74.4	3.26	
New Richmond	96	54	75.7	2.74	
New Waterford	93	47	71.9	3.44	
North Lewisburg	98	48	75.2	6.35	
North Royalton	98	50	73.3	3.77	
Norwalk	98	47	73.1	3.97	
Oberlin	98	46	73.1	5.32	
Ohio State University	96	48	74.6	4.86	
Orangeville	98	41	71.7	1.55	
Ottawa	99	47	74.1	3.25	
Pataskala	95	48	74.2	4.83	
Perry	.....	.....	.....	3.87	
Philo	99	51	75.9	4.71	
Plattsburg	94	49	74.2	3.48	
Pomeroy	98	49	76.3	4.88	
Portsmouth *a*	.....	.....	.....	3.09	
Portsmouth *b*	98	53	77.6	3.09	
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Pulse	.....	.....	.....	2.66	
Richwood	101	51	77.6	6.28	
Ridgeville Corners	93	42	72.2	5.45	
Ripley	98	51	75.9	2.91	
Rittman	94	42	71.0	5.57	
Rockyridge	97	50	73.2	2.85	
Rosewood	95	45	75.2	5.52	
Seaman	105	43	77.7	5.20	
Shenandoah	97	49	73.1	3.63	
Sidney	99	49	76.3	6.21	
Sinking Spring	91	52	74.9	2.65	
Somerset	97	.....	.....	4.11	
Springboro	.....	.....	.....	4.63	
Strongsville	.....	.....	.....	5.75	
Thurman	96	50	76.1	2.32	
Tiffin	95	52	74.0	4.56	
Upper Sandusky	96	49	74.3	6.08	
Urbana	94	50	73.6	5.12	
Vanceburg	95	51	75.8	1.51	
Vanwert	96	..	.....	6.00	
Vermillion	94	50	72.2	3.11	
Vickery	98	47	73.0	3.25	
Walnut	.....	.....	.....	4.62	
Warsaw	104	44	74.8	4.27	
Wauseon	97	48	73.4	4.52	
Waverly	97	50	77.4	3.42	
Waynesville	96	48	74.3	3.25	
Wellington	96	48	73.2	4.15	
Westerville	92	50	73.4	4.88	
Willoughby	.....	.....	.....	2.31	
Wooster	94	45	71.1	3.73	
Zanesville	.....	.....	.....	4.55	
Oklahoma.					
Arapaho	99	62	80.6	4.13	
Beaver	103	59	78.0	5.79	
Burnett	96	60	79.8	2.65	
Clifton	93	60	78.8	4.57	
Fort Reno	95	61	78.2	2.42	
Fort Sill	95	61	78.0	14.00	
Guthrie	95	64	80.2	3.42	
Hennessey	.....	64	.....	6.94	
Hopeton	98	63	79.2	5.08	
Kingfisher	97	60	80.4	5.01	
Mangum	93	63	77.6	6.01	
Newkirk	98	62	79.2	5.33	
Norman	103	60	80.6	1.35	
Pawhuska	97	60	78.8	11.29	
Perry	96	63	79.2	5.87	
Prudence	98	.....	.....	7.01	
Putnam	98[j]	50[j]	76.9[j]	3.55	
Sac and Fox Agency	97	60	78.8	5.39	
Stillwater	96	64	79.4	4.54	
Waukomis	100	60	80.2	7.36	
Winnview	99	60	80.2	7.24	
Woodward	95	65	82.6	.....	
Oregon.					
Albany *b*	.....	.....	.....	0.03	
Arlington	102	42	75.1	0.00	
Ashland *b*	96	40	68.8	0.00	
Aurora	98	51	68.8	0.00	
Aurora (near)	94	41	64.2	0.43	
Bandon	72	43	56.0	0.10	
Bay City	77	43	60.4	0.44	
Beulah	104	36	70.3	0.35	
Bialock	104	50	78.0	T.	
Brownsville *[1]	91	49	63.8	0.00	
Bullrun	92	44	64.6	0.28	
Burns (near)	98	38	68.0	T.	
Cascade Locks	96	48	68.4	0.08	
Comstock *[1]	95	52	66.2	T.	
Coquille River	.....	.....	.....	0.02	
Corvallis	94	40	65.0	0.07	
Dayville	96	40	68.6	0.12	
Ella	.....	.....	.....	0.01	
Eugene [i]	90	44	65.6	T.	
Fairview	86	40	60.6	T.	
Falls City	94	40	63.4	0.07	
Gardiner	78	45	60.8	0.20	
Glenora	99	40	64.1	0.30	
Government Camp	80	32	55.9	0.52	
Grants Pass	99	40	69.6	0.00	
Happy Valley	97	30	63.6	0.04	
Heppner	99	40	68.2	T.	
Hood River (near)	98	42	68.2	T.	
Jacksonville	95	43	69.6	0.09	
Joseph	91	37	65.0	0.19	
Junction City *[1]	96	50	67.0	0.05	
Kerby	97	36	67.0	0.00	
Klamath Falls	98°	36°	70.4°	.....	
Lafayette *[1]	98	54	69.9	0.20	
Lagrande	99	41	70.4	0.00	
Lakeview	95	35	67.6	T.	
Langlois	81	42	61.4	0.00	
Lonerock	97	31	64.0	0.00	
Lorella	98	30	64.5	0.00	
McMinnville	96	40	64.3	0.50	
Oregon—Cont'd.	°	°	°	*Ins.*	*Ins.*
Merlin *[1]	100	52	71.0	0.00	
Monmouth *a* *[1]	93	55	72.0	0.03	
Monmouth *b*	96	39	64.5	0.31	
Monroe	94	42	65.0	T.	
Mount Angel	95	46	67.2	0.03	
Nehalem	.....	.....	.....	0.24	
Newberg	99	40[f]	67.6[e]	0.22	
Newbridge	102	37	69.0	T.	
Newport	68	42	56.0	0.59	
Pendleton	107	42	73.4	0.03	
Placer	.....	.....	.....	0.00	
Prineville	98	32	64.3	T.	
Riddles *[1]	95	42	66.8	0.00	
Riverside	106	28	68.4	0.15	
Salem *b*	96	35	66.0	0.00	
Sheridan *[1]	94	50	65.1	0.00	
Silver Lake	95	26	68.6	0.00	
Silverton *[1]	94	58	68.9	0.30	
Siskiyou *[1]	89	56	71.0	0.00	
Sparta	94	39	67.2	0.17	
Springfield *[1]	88	51	66.4	0.00	
Stafford	97°	45[d]	67.2°	1.15	
The Dalles	99	45	72.1	0.00	
Tillamook Rock	.....	.....	.....	0.52	
Toledo	85	37	60.3	T.	
Umatilla	.....	.....	.....	0.02	
Vale	101	39	70.6	0.02	
Vernonia	107	38	63.4	0.02	
Westfork *[1]	100	48	68.3	0.00	
Weston	97	42	68.8	0.04	
Williams	93	38	66.2	0.00	
Pennsylvania.					
Altoona	91	46	70.9	3.67	
Aqueduct	.....	.....	.....	1.80	
Athens	96	41	71.7	3.90	
Beaver Dam	.....	.....	.....	2.76	
Bethlehem	.....	.....	.....	3.08	
Brookville	.....	.....	.....	5.52	
Browers Lock	.....	.....	.....	2.29	
Butler	91	44	70.6	3.87	
Carlisle [f]	93	43	69.6	2.60	
Cassandra	88	47	69.0	4.36	
Cedarrun	.....	.....	.....	0.81	
Centerhall	89	45	70.8	2.36	
Chambersburg	94	.....	.....	3.01	
Coatesville	100	47	75.8	3.46	
Confluence	.....	.....	.....	6.64	
Coopersburg	91	50	73.2	4.53	
Davis Island Dam	.....	.....	.....	3.00	
Derry Station	97	48	73.4	4.50	
Driftwood	.....	.....	.....	3.67	
Duncannon	.....	.....	.....	2.64	
Dushore	93	35	68.8	2.03	
East Bloomsburg	.....	.....	.....	3.69	
East Mauch Chunk	93	43	73.2	4.06	
Easton	91	50	74.0	2.89	
Ellwood Junction	.....	.....	.....	2.79	
Emporium	93	45	70.4	4.32	
Everett [e]	91	48	72.0	3.33	
Farrandsville	.....	.....	.....	2.22	
Forks of Neshaminy *[1]	96	64	76.0	4.49	
Franklin	94	43	71.2	4.75	
Frederick	.....	.....	.....	3.27	
Freeport	.....	.....	.....	3.34	
Girardville	.....	.....	.....	4.99	
Grampian	90	50	71.4	3.84	
Greensboro	98	50	74.2	6.25	
Hamburg	98	54	74.2	6.30	
Hawley	92	46	68.8	5.25	
Hawthorn	99	46	71.2	6.95	
Hews Island Dam	.....	.....	.....	2.50	
Huntingdon *a*	95	45	72.4	3.89	
Huntingdon *b*	.....	.....	.....	3.68	
Irwin	.....	.....	.....	4.63	
Johnstown	97	48	73.4	3.20	
Karthaus	.....	.....	.....	1.58	
Keating	.....	.....	.....	3.27	
Kennett Square	97	49	74.7	2.98	
Lansdale	.....	.....	.....	3.18	
Lawrenceville	94	43	70.0	3.15	
Lebanon	96	43	72.0	1.91	
Leroy	90	49	70.5	1.93	
Lewisburg	95	44	73.4	1.53	
Lock Haven *a*	97	47	75.0	2.40	
Lock Haven *b*	.....	.....	.....	2.16	
Lock No. 4	.....	.....	.....	6.05	
Lycippus	95	51	73.2	3.79	
Mifflin	.....	.....	.....	2.30	
Nisbet	.....	.....	.....	2.11	
Oil City	.....	.....	.....	5.39	
Ottsville	.....	.....	.....	3.13	
Parker	.....	.....	.....	6.18	
Philadelphia	96	60	77.2	5.16	
Quakertown	96	46	74.0	4.23	
Reading [g]	.....	.....	74.3	2.94	
Renovo *a*	.....	.....	.....	3.11	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Pennsylvania—Cont'd.					
Renovo *b*	92	45	72.3	3.13	
Ridgway				3.81	
Saegerstown	93	41	69.6	5.84	
St. Marys		43		3.04	
Salem Corners	89	42	69.5	4.18	
Scranton	94	42	71.2	4.73	
Selsholtzville				8.24	
Selinsgrove *a*	94	46	73.4	2.42	
Shawmont				3.84	
Shinglehouse	96	40	69.6	5.04	
Sinnamahoning				1.92	
Smethport	90	38	67.6	5.40	
Smiths Corners				3.63	
Somerset	93	42	68.6	4.60	
South Eaton	91	46	71.6	2.39	
State College	91	50	72.0	2.14	
Sunbury				1.25	
Swarthmore	97	61	77.0	4.26	
Swiftwater				4.56	
Towanda	92	41	70.7	2.47	
Trout Run				1.87	
Uniontown	92	50	73.9	6.44	
Warren	90	42	68.0	5.73	
Wellsboro	92	40	70.3	3.37	
West Chester	96	54	75.4	2.94	
West Newton				4.27	
Wilkesbarre	94	46	73.8	3.91	
Williamsport	91	57	75.0	2.00	
York	95	49	74.8	5.32	
Rhode Island.					
Bristol	84	58	70.9	3.21	
Kingston	89	49	69.5	2.71	
Lonsdale				4.69	
Pawtucket	89	60	73.8	4.80	
Providence *a*	94	54	74.8	4.69	
Providence *c*	90	54	72.0	4.97	
South Carolina.					
Allendale	98	55	80.6	3.12	
Anderson				3.30	
Batesburg	103	58	81.0	2.50	
Beaufort	98	66	81.8	2.12	
Blackville	100	57	81.0	3.41	
Calhoun Falls				4.22	
Camden				5.50	
Central	98	56	78.8	4.22	
Cheraw *a*	103	57	81.8	3.05	
Cheraw *b*				3.45	
Clemson College	98	54	78.4	4.00	
Conway				7.89	
Darlington				3.66	
Edisto				3.43	
Effingham				2.25	
Florence	100	60	81.4	3.31	
Gaffney				3.68	
Georgetown	95	63	79.1	4.50	
Greenville	97	53	76.9	1.64	
Greenwood	105	57	82.3	2.17	
Holland	99	47	77.8	4.01	
Kingstree *a*	98	58	80.2	3.79	
Kingstree *b*				3.82	
Little Mountain	105	60	82.0	3.61	
Longshore	103	56	80.2	3.22	
Pinopolis *[1]	94	62	78.5	3.99	
St. Georges	100	57	80.4	2.66	
St. Matthews	101	60	80.4	3.30	
St. Stephens				2 46	
Santuck	104	52	80.3	6.30	
Shaws Fork	101	54	78.6	2.46	
Smiths Mills				7.41	
Society Hill	99	61	80.8	4.74	
Spartanburg	101	55	79.4	3.09	
Statesburg	101	61	81.0	1.93	
Summerville	96	58	78.6	5.60	
Temperance	101	55	79.3	10.16	
Trenton	98	67	81.8	1.58	
Trial	97	54	77.0	5.14	
Winnsboro	97	60	77.3	2.12	
Yemassee	103	59	82.6	5.28	
Yorkville	103	58	81.6	3.54	
South Dakota.					
Aberdeen	106	42	74.6	2.90	
Alexandria	99	40	72.8	3.18	
Armour	102	40	73.0	2.28	
Ashcroft	105	32	70.2	0.32	
Bowdle	103	33	70.4	1.08	
Brookings	95	40	69.2	0.73	
Canton	92	46	71.6	6.83	
Centerville				5.67	
Chandler	109	48	75.0	2.40	
Clark				0.91	
Desmet	97	45	70.8	1.78	
Doland	105	38	75.0	2.68	
Elkpoint	94	54	73.9	2.64	
Farmingdale				1.54	
Flandreau	96	44	71.4	1.41	
Forestburg	102	42	68.8	0.28	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
South Dakota—Cont'd.					
Forest City	110	45	76.5	0.47	
Fort Meade	104[1]	47	77.1*	0.29	
Gann Valley	107	42	74.7	1.45	
Gary	98	57	77.2	2.55	
Goudyville	104	40	71.5	1.24	
Highmore	104	45	78.0	1.81	
Hitchcock				1.74	
Hotch City				0.77	
Hot Springs	101	44	68.8	0.58	
Howard	97	39	71.4	1.98	
Interior	111	48	74.4	1.10	
Ipswich	104	37	72.1	1.69	
Kimball	107	44	74.2	3.19	
Leola		39		1.43	
Leslie	109	36	72.8	1.05	
Mellette	106	40	74.0	2.08	
Menno	96	45	71.6	3.59	
Millbank	100	46	71.4	2.28	
Mitchell	98	45	71.6	2.91	
Montrose	90	47	70.8	0.97	
Oelrichs	105	49	74.0	2.30	
Parker	94	43	71.2	3.76	
Plankinton	106	48	73.2	2.20	
Redfield	105	40	73.6	1.31	
Rochford	92	35	62.3	3.14	
Rosebud	103	40	76.1	1.45	
St. Lawrence	105	40	73.7	1.82	
Shiloh	107	43	72.0	2.18	
Silver City				2.81	
Sioux Falls	92	38	68.8	2.87	
Spearfish	98	40	68.0	2.08	
Tyndall	93	47	72.3	4.81	
Waubay	100	41	71.2	0.93	
Wentworth	94	44	70.3	1.38	
Wessington Springs	100	52	72.6	0.46	
Whiteswan	101	48	75.0	2.40	
Wolsey				1.27	
Tennessee.					
Andersonville	97	54	75.5	6.13	
Arlington	97	51	78.8	3.57	
Ashwood	100	56	79.3	3.18	
Bluff City				4.84	
Bolivar	98	54	78.4	3.56	
Bristol	94	50	73.3	5.07	
Brownsville	99	61	78.6	2.61	
Byrdstown	98	52	76.1	6.31	
Carthage	100	55	79.1	4.69	
Clinton				6.53	
Covington	99	58	81.0	1.61	
Decatur	98	56	77.0	4.49	
Dover		49		3.78	
Dyersburg	97	57	79.7	3.58	
Elizabethton	94	52	76.4	3.58	
Elk Valley		54		3.00	
Erasmus	94	44	71.5	6.94	
Florence	97	63	79.0	5.53	
Franklin	98	55	78.4	6.33	
Grace *[1]	100	62	76.1	3.80	
Greeneville	96	52	74.4	3.17	
Harriman	98	54	76.1	6.54	
Hohenwald	98	51	77.0	3.81	
Jackson	96	53	78.8	2.60	
Johnsonville	100	48	78.0	5.70	
Jonesboro *[1]	89	61	74.1	1.99	
Kingston				6.81	
Lafayette *[5]	100	52	77.3	7.58	
Lewisburg				4.44	
Lynnville	97	58	78.1	5.45	
Madison		53		6.96	
Maryville *[5]	100	57	77.7	2.72	
Milan	100	55	80.0	6 52	
Newport	100	53	76.6	2.94	
Nunnelly	97	54	77.2	3.33	
Oak Hill	97	50	76.0	6.60	
Palmetto	100	52	79.0	3.66	
Peryear *[5]	100	63	82.1	2.20	
Pope	100	48	77.0	4.87	
Rogersville	93	52	74.2	4.15	
Rugby	96	47	73.7	6.45	
Savannah	100	55	80.1	4.49	
Sewanee	95	58	75.4	5.91	
Silverlake	86	44	68.4	5.56	
Springdale	99	51	76.3	3.24	
Springfield	100	50	78.6	7.00	
Sylvia	98	58	78.2	5.95	
Tazewell				4.16	
Tellico Plains	100	56	77.2	6.24	
Tracy City	93	52	73.8	4.26	
Trenton	98	53	80.0	4.04	
Tullahoma	98	55	76.2	4.55	
Union City	97	55	78.4	2.70	
Waynesboro	98	50	77.3	7.29	
Wildersville	94	54	77.4	4.00	
Yukon	100	62	79.1	4.38	
Texas.					
Alvin				12.70	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Texas—Cont'd					
Anna	102	59	80.3	2.04	
Anson				1.80	
Arthur				2.68	
Austin *a*	101	65	82.6	4.20	
Austin *b* *[5]	99	64	81.2		
Ballinger	101	62	80.5	1.73	
Beaumont	101	75	87.9	0.65	
Beeville	105	68	84.0	1.93	
Blanco	104	61	81.2	2.40	
Boerne *[1]	99	67	82.2	3.29	
Brazoria	94	72	81.8	1.89	
Brenham	97	68	82.2	2.76	
Brighton	97	70	84.2	0.20	
Brownwood				0.57	
Burnet *[1]	100	63	79.4	1.99	
Camp Eagle Pass		60		0.00	
Childress	95	66	78.8	5.86	
College Station	94	65	81.2	1.50	
Colorado				1.58	
Columbia	92[d]	68[d]	81.5[d]	4.32	
Conroe *	98	63	82.0	2.14	
Corsicana	102	61	84.8	2.91	
Cuero	99	69	84.4	1.24	
Dallas	104	61	81.5	2.31	
Danevang	102	69	84.4	1.74	
Desdimonia	110[f]	66[f]	86.4[f]	0.28	
Dublin	100	60	80.1	2.60	
Duval	99	67	81.8	6.40	
Emory	102	59	82.5	0.86	
Estelle	101	62	81.9	3.72	
Fort Brown	100	71	82.0	0.20	
Fort Clark	99	69	82.6	3.31	
Fort McIntosh	107	71	87.8	0.61	
Fort Ringgold	106	67	86.5	2.74	
Fredericksburg *[1]	98	61°	80.0°	1.65	
Fruitland	101	62	80.4	3.51	
Gainesville	98[c]	62°	80.4[f]	4.65	
Georgetown *[5]	100	67	83.5	3.02	
Grapevine	107°	63[b]	83.4°	4.30	
Hale Center	94	63	76.6	6.43	
Hallettsville	99	68	83.4	2.02	
Hearne	99	69	83.9	0.95	
Henrietta	100	62	81.7	6.67	
Hewitt				0.75	
Hondo				1.85	
Honeygrove				0.56	
Houston	94	70	81.9	2.47	
Hulen		67		5.05	
Huntsville	96	63	82.4	4.05	
Jacksonville	98	59	82.0	3.09	
Jasper	100	64	82.8	0.74	
Kent				2.44	
Kerrville	99	56	79.6	1.89	
Lampasas	101	58	81.8	1.16	
Langtry				3.63	
Laureles Ranch				0.00	
Llano *[5]	105	70	85.5	2.10	
Longview	104	60	84.2	1.81	
Luling	100	67	83.0	2.85	
Mann	100	63	81.2	2.36	
Marathon	98	44	73.8	0.96	
Monahans				0.70	
Mount Blanco	96	61	76.3	5.12	
New Braunfels	102	64	82.7	5.94	
Panter				1.67	
Paris *a*	102	63	82.2	1.46	
Point Isabel *[1]	96	80	85.2	0.00	
Rhineland	103	63	82.0	6.95	
Roby	104[j]	58[j]	79.9[j]	1.93	
Rock Island	95	67	81.6	1.45	
Rockport *[1]	89	70	80.2		
Runge	104	69	85.2	0.69	
Sabine Pass				0.97	
San Antonio	102	70	84.7	3.17	
Sanderson		75		0.00	
San Marcos	96	63	78.0	5.58	
Sherman	98	65	81.9	3.30	
Sugarland	103	72	86.1	6.62	
Sulphur Springs	101	62	81.7	1.75	
Temple *a*	97	66	82.0	0.70	
Temple *b*	98	62	81.4	0.94	
Tyler	99	60	82.2	1.79	
Valentine	99			2.06	
Victoria				3.77	
Waco	101	67	84.4	0.10	
Waxahachie	104	59	83.1	1.00	
Weatherford	106	53	83.6	1.99	
Wichita Falls				8.35	
Utah.					
Bluecreek *[1]	97	48	74.8	T.	
Brigham				0.05	
Castledale	94	49	68.4	1.41	
Cisco	101	52	77.8	0.03	
Corinne	99	38	73.8	0.93	
Croydon [f]	93	34	65.6	T.	
Fillmore	102	43	75.4	0.01	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Utah—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fort Duchesne	97	34	71.0	0.71	
Frisco	100	55	75.8	0.81	
Giles	105	52	81.0	0.93	
Grover	94	42	66.4	3.07	
Heber	94	38	67.8	1.61	
Huntsville	.....	.....	.....	0.17	
Kelton *1	100	60	75.7	0.90	
Levan	94	45	72.0	0.25	
Loa	93	39	67.9	2.20	
Logan	93	48	72.4	0.60	
Manti	98	46	73.2	1.02	
Marysvale [2]	.....	.....	60.0	1.14	
Millville	.....	.....	.....	0.26	
Minersville	99	50	75.6	1.20	
Moab	104	52	80.2	0.55	
Mount Pleasant	104	47	74.6	0.76	
Ogden *1	101	59	76.9	T.	
Pahreah	103	50	78.1	0.60	
Parowan	97	45	72.8	0.72	
Pinto	94	40	69.4	0.05	
Promontory *1	102	58	74.6	0.28	
Richfield	94	59	75.3	0.16	
St. George	107	51	82.2	0.05	
Scipio	97	42	73.6	0.58	
Snowville	95	41	70.4	0.17	
Soldier Summit	100	.....	.....	0.55	
Terrace *1	96	50	72.0	T.	
Tooele	98	53	75.6	0.63	
Tropic	97	38	66.6	1.50	
Vernal	94	50	73.0	0.64	
Woodruff	88	30	62.5	0.98	
Vermont.					
Bennington	92	44	70.2	6.48	
Burlington	89	54	71.0	5.37	
Chelsea	90	38	65.5	2.38	
Cornwall	93	43	70.2	4.28	
Derby	88	40	66.2	6.23	
Hartland	91	36	66.2	5.42	
Jacksonville	88	40	67.1	6.12	
Norwich	93	38	66.8	4.43	
St. Johnsbury	90	38	67.0	4.36	
Vernon *6	93	56	72.8	5.77	
Wells	92	41	69.9	3.99	
Woodstock	92	37	67.0	4.71	
Virginia.					
Alexandria	98	55	78.5	4.84	
Ashland	99	52	78.0	6.76	
Barboursville	96	53	77.0	5.46	
Bigstone Gap	96	48	73.8	6.12	
Birdsnest *1	91	63	77.4	4.00	
Blacksburg	89	45	70.2	3.38	
Buckingham	94	50	74.6	2.97	
Burkes Garden	85	41	65.2	4.64	
Callaville	94	48	75.8	5.53	
Christiansburg	.....	.....	.....	2.64	
Clarksville	.....	.....	.....	3.76	
Clifton Forge	95	48	75.0	1.42	
Columbia	.....	.....	.....	1.55	
Dale Enterprise	99	45	74.1	3.15	
Danville	.....	.....	.....	3.85	
Doswell	101	50	80.6	2.45	
Farmville	98	51	78.4	2.50	
Fontella	99	52	77.7	3.31	
Fredericksburg	95	54	77.4	3.39	
Grahams Forge [3]	89	45	68.2	1.45	
Hampton	92	62	79.0	6.72	
Hot Springs	89	35	66.8	2.76	
Lexington	93	50	74.8	3.18	
Manassas	97	51	78.1	1.57	
Marion	92	45	72.6	5.12	
Miller School	91	49	72.8	5.84	
Petersburg	96	58	78.7	6.13	
Radford	.....	.....	.....	3.75	
Richmond (near)	95	57	77.7	4.24	
Rockymount	93	50	76.6	5.00	
Salem	94	56	77.5	3.46	
Speers Ferry	.....	.....	.....	7.15	
Spottsville	100	50	78.4	6.92	
Stanardsville	96	55	76.6	3.16	
Staunton	97	49	76.3	1.33	
Stephens City	99	50	76.3	2.09	
Sunbeam	96	49	77.2	10.41	
Warrenton	97	62	78.2	2.08	
Warsaw	96	48	78.2	2.49	
West Point	96	42	72.0	5.76	
Woodstock	97	51	73.9	2.79	
Wytheville	91	46	71.8	3.85	
Washington.					
Aberdeen	90	44	62.6	0.32	
Anacortes	.....	.....	.....	1.26	
Ashford	.....	.....	.....	0.54	
Bremerton	94	44	64.0	0.52	
Bridgeport [4]	106	50	75.1	0.25	
Brinnon	87	47	63.4	0.26	
Cedar Lake	.....	.....	.....	1.19	
Cedonia	90	37	62.6	0.82	

Stations	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Washington—Cont'd.	°	°	°	*Ins.*	*Ins.*
Centerville	103	34	67.6	0.00	
Chehalis	97	40	64.2	T.	
Cheney	.....	.....	.....	0.02	
Clearwater	86	40	60.6	0.40	
Cle Elum	96	34	63.5	T.	
Colfax	93	32	64.1	0.03	
Connell	.....	.....	.....	0.00	
Coupeville	94	40	61.5	1.59	
Crescent	100	.....	.....	0.29	
Dayton	97	41	69.7	0.01	
Ellensburg	93	42	67.7	0.05	
Ellensburg (near)	103	44	70.9	0.01	
Fort Simcoe	101	45	72.6	0.00	
Grandmound	93	41	64.4	0.02	
Hooper	104	42	73.4	T.	
Kennewick	106	47	77.8	0.05	
Lacenter	98	37	65.8	0.33	
Lakeside	99	46	73.1	0.15	
Lind	112	36	75.6	0.03	
Mayfield	96	36	64.8	0.13	
Moxee Valley	102	40	72.0	0.12	
New Whatcom	96	43	69.8	0.90	
Northbend	90	39	63.5	0.90	
Northport	98	37	65.8	0.87	
Olga	87	42	59.2	0.60	
Olympia	95	42	64.2	0.02	
Orcas Island	90	41	62.8	0.55	
Pinehill	99	43	69.7	0.00	
Pomeroy	98	54	80.6	0 01	
Port Townsend	87	46	61.1	1.13	
Pullman	96	39	67.0	0.12	
Ritzville	.....	.....	.....	0.12	
Rosalia	95	37	66.1	0.33	
Silvana	88	41	61.0	1.11	
Snohomish	88	42	63.0	1.19	
Snoqualmie	93	45	66.2	0.78	
Southbend	91	41	61.4	0.50	
Sprague	.....	.....	.....	T.	
Sunnyside	101	45	73.7	0.00	
Tunnel	.....	.....	.....	0.80	
Union City	90	42	63.7	T.	
Usk	96	43	67.5	1.12	
Vancouver	93	44	65.3	0.10	
Vashon	89	45	63.0	0.71	
Waterville	103	37	69.0	0.13	
Wenatchee (near)	99	43	70.3	0.12	
West Virginia.					
Beckley	90	41	67.8	0.20	
Beverly	94	40	71.4	6.02	
Bluefield	87	46	70.3	4.09	
Buckhannon *a*	.....	.....	.....	4.87	
Buckhannon *b*	95	46	72.9	.....	
Burlington	94	47	73.6	2.18	
Cairo	97	42	74.2	4.53	
Charleston	.....	.....	.....	5.70	
Dayton	92	44	71.4	6.31	
Eastbank	.....	.....	.....	2.70	
Elkhorn	90	48	72.0	3.22	
Fairmont	.....	.....	.....	5.81	
Glenville	92	51	73.3	4.34	
Grafton	92	45	72.8	4.68	
Green Sulphur	91	47	73.0	0.94	
Hamlin	93	50	75.5	2.94	
Harpers Ferry	.....	.....	.....	2.76	
Hinton *a*	.....	.....	.....	1.23	
Hinton *b*	96	50	75.5	.....	
Huntington	97	52	76.8	6.04	
Kingwood	91	44	71.3	4.53	
Madison	90	.....	.....	6.62	
Marlinton	89	45	70.2	2.95	
Martinsburg	97	52	74.9	1.15	
Morgantown	96	50	74.3	3.38	
New Cumberland	98	49	73.0	5.91	
New Martinsville	95	51	73.3	4.29	
Nuttallburg	90	48	72.2	3.89	
Oceana	91	51	73.4	2.50	
Oldfields	98	45	73.4	4.09	
Parsons	93	49	71.6	4.63	
Philippi *a*	94	48	73.2	7.92	
Philippi *b*	.....	.....	.....	5.61	
Point Pleasant	96	51	77.2	4.15	
Powellton	91	50	72.2	1.96	
Romney	92	51	74.8	2.59	
Rowlesburg	.....	.....	.....	4.70	
Terralta	.....	.....	.....	3.61	
Upper Tract	100	43	74.2	1.89	
Weston *a*	.....	.....	.....	5.51	
Weston *b*	97	49	74.4	.....	
Wheeling *a*	.....	.....	.....	3.72	
Wheeling *b*	97	58	78.6	3.51	
Wisconsin.					
Amherst	88	44	68.8	5.99	
Antigo	94	40	67.4	3.24	
Bayfield	89	42	68.6	3.18	
Beloit	92	55	73.0	4.02	
Brodhead	94	44	72.2	4.40	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Wisconsin—Cont'd.	°	°	°	*Ins.*	*Ins.*
Butternut [5]	97	35	68.2	1.94	
Chilton	92	50	70.8	2.64	
Citypoint	92	49	71.2	4.18	
Delavan	96	50	73.2	2.98	
Dodgeville	91	41	72.5	2.31	
Easton	92	39	70.8	3.58	
Eau Claire	92	46	71.6	1.62	
Florence	90	44	65.2	2.41	
Grand River Locks	.....	.....	.....	2.83	
Grantsburg	95	42	70.5	2.08	
Gratiot	93	45	74.4	7.60	
Hartford	95	45	71.0	3.65	
Hartland	92	49	70.0	2.34	
Harvey	96	49	71.0	4.27	
Hayward	93	40	68.4	1.78	
Heafford Junction	90	49	69.4	2.35	
Hillsboro	93	40	70.5	1.50	
Koepenick *1	92	58	69.1	2.40	
Lancaster	91	46	71.3	4.94	
Lincoln	87	50	68.6	6.14	
Madison	91	53	71.8	3.22	
Manitowoc	90	48	66.5	3.40	
Meadow Valley	92	43	70.0	2.46	
Medford	.....	34	.....	0.75	
Menasha	.....	.....	.....	3.52	
Neillsville	90	42	69.0	2.61	
New Holstein	.....	.....	.....	3.55	
New London	90	45	69.3	6.50	
Oconto	90	46	69.4	5.70	
Osceola	94	36	69.7	1.66	
Oshkosh	87	.....	.....	2.15	
Pepin	93	41	72.2	1.53	
Portage	92	49	72.5	2.57	
Port Washington	93	48	67.8	3.82	
Prairie du Chien	96	46	74.4	1.41	
Prentice *1	92	48	65.6	3.07	
Racine	92	50	70.2	4.26	
Sharon [7]	94	50	72.6	2.99	
Shawano	91	46	68.1	5.15	
Spooner	95	41	70.8	2.78	
Stevens Point	91	45	69.4	3.28	
Sturgeon Bay Canal *10	85	48	65.4	.....	
Two Rivers *10	88	58	68.4	.....	
Valley Junction	92	40	69.5	2.19	
Viroqua	89	50	70.8	3.14	
Watertown	91	49	70.8	3.72	
Waukesha	92	52	69.8	2.14	
Waupaca	91	49	70.3	5.13	
Wausau	91	45	68.3	2.96	
West Bend	93 [f]	50 [g]	72.1 [f]	2.80	
Westfield	92	47	71.8	1.86	
Whitehall	90	46	69.4	1.60	
Wyoming.					
Alcova	101	32	65.1	0.60	
Basin	107	41	74.1	0.22	
Bedford *	88	32	61.4	.....	
Big Piney	85	33	59.4	0.50	
Bitter Creek	108	32	68.8	0.80	
Buffalo	96	43	67.4	0.76	
Burns	90	28	58.8	1.01	
Carbon	104	40	68.4	1.11	
Centennial	79	34	57.6	1.53	
Douglas	100	40	68.6	2.15	
Embar	98	43	69.2	.....	
Evanston	89	35	62.9	0.81	
Fort Laramie	103	46	71.7	1.84	
Fort Washakie	93	42	66.4	0.75	
Fort Yellowstone	88	34	61.4	1.42	
Four Bear	85	32	59.6	1.56	
Hecla	92	43	65.6	1.89	
Hyattville	101	39	69.7	.....	
Laramie	87	40	62.2	2.01	
Lusk	100	43	68.8	0.57	
Rawlins	91	40	64.4	1.96	
Rocksprings	92	29	62.7	2.75	
Sheridan	94	41	65.6	1.53	
Thayne	88	32	62.0	1.52	
Thermopolis	103	41	70.6	.....	
Wamsutter	95	45	69.2	0.07	
Wheatland	100	41	68.7	1.28	
Mexico.					
Ciudad P. Diaz	98	74	85.7	3.58	
Coatzacoalcos [8]	.....	.....	81.1	.....	
Leon de Aldamas	87	53	69.2	5.69	
Puebla	79	51	64.0	8.40	
Tampico [8]	.....	.....	82.8	.....	
Vera Cruz [8]	.....	.....	82.0	.....	
Porto Rico.					
Adjuntas	90	58	74.1	10.34	
Aguadilla	89	74	82.0	4.68	
Arecibo	88	59	75.6	6.92	
Bayamon	92	68	80.5	9.42	
Caguas	93	63	79.8	8.47	
Canovanas	86	73	78.5	10.20	
Cayey	94	67	80.0	7.90	
Cidra	88	63	77.8	11.45	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Porto Rico—Cont'd	°	°	°	*Ins.*	*Ins.*
Corozal	92	61	78.3	13.69	
Fajardo	89	69	81.6	5.58	
Guayama	92	60	80.2	6.40	
Humacao	92	66	80.8	7.35	
Isabela	91	68	81.8	2.98	
Lajas	95	67	80.1	6.76	
Loiza	84	71	77.4	5.53	
Los Banos				4.11	
Luquillo	93	72	80.1	10.60	
Manati	92	68	80.0	9.70	
Mayaguez	92	68	78.7	14.41	
Morovis	88	67	77.9	3.95	
Puerta de Tierra	90	72	81.1	8.14	
San Lorenzo	91	68	80.2		
Vieques	90	69	78.6	6.45	
Yanco	93	62	78.2	3.81	
Late reports for June, 1899.					
Alaska.					
Juneau	68	40	51.2	5.63	
Kenai	68	31	48.0	0.68	
Tyoonok	68	37	53.2	1.20	
Arkansas.					
Conway	103		80.6		
California.					
Drytown	106	46	73.6	0.09	
Glendora				0.00	
Jolon				T.	
Kernville				0.16	
Los Alamos				0.61	
Mount Frazier				0.60	
Mountain View				0.00	
Placerville	101	42	69.0	0.88	
San Miguel Island				2.00	
West Palmdale				0.00	
Connecticut.					
Winsted [1]	88	49	66.8		
Florida.					
Earnestville	101	63	82.8	9.88	
Kansas.					
Delphos	96	52	74.2	10.87	
Osborne				3.92	
Kansas—Cont'd.					
Yates Center		52		5.19	
Maryland.					
McDonogh				2.61	
Massachusetts.					
Leicester Hill	91	45	67.5	4.69	
Michigan.					
Holland *[10]	81	51	66.8		
Middle Island *[10]	85	47	60.8		
North Manitou Isl'd *[10]	86	42	61.6		
Vermillion Point *[10]	80	36	58.0		
Missouri.					
Galena				2.05	
Rhineland				1.56	
St. Charles	94	50	76.6	1.54	
Nebraska.					
Kennedy		28	66.3		
Redcloud				4.00	
New Hampshire.					
Littleton	87	39	64.2	3.76	
New Jersey.					
Staffordville				1.75	
New Mexico.					
Eddy	103	54	78.2	1.60	
Engle	95	34	71.5	0.55	
New York.					
Big Sandy *[10]	82	45	65.8		
Charlotte *[10]	95	50	67.5		
Madison Barracks	89	42	64.8	0.55	
Salisbury Mills	94	42	69.0		
Ohio.					
Vanwert	95	54	76.6	1.80	
Rhode Island.					
Providence *c*	93	52	69.6	3.75	
Texas.					
San Antonio	97	66	81.2	3.88	
Virginia.					
Fontella				3.95	
Washington.					
Bremerton	79	38	57.2	1.84	
Northbend	77	35	53.4	3.98	
Shoalwater Bay *[10]	64	46	55.0		
Wisconsin.					
Sturgeon Bay Canal *[10]	83	39	58.6		
Two Rivers *[10]	78	50	61.0		

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.
[7] Mean from hourly readings of thermograph.
[9] Mean of sunrise and noon.
[10] Mean of sunrise, noon, sunset, and midnight.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "[5] a" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS.

Minnesota, Detroit City, June, 1899, make total precipitation 8.06, instead of 8.66.

Missouri, Gorin, May, 1899, make total precipitation 9.24, instead of 7.84.

December, 1898, REVIEW, page 562, column 2, line 30 from the top, read Dakota Republican, instead of Hutchinson County Herald. Page 567, column 1, lines 6–8, for H. W. Richardson read Norman B. Conger. See February, 1899, REVIEW, page 60.

TABLE III.—*Mean temperature for each hour of seventy-fifth meridian time, July*, 1899.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Mid'n't.	Mean.
Bismarck, N. Dak....	64.2	62.5	61.0	60.4	59.1	57.8	57.9	61.0	64.5	68.8	71.7	74.2	76.4	77.8	78.9	79.7	80.4	80.1	79.3	77.9	75.1	71.2	68.3	65.9	69.7
Boston, Mass	67.0	66.4	65.9	65.4	65.2	66.0	68.7	71.2	73.8	75.8	76.6	77.6	78.5	78.5	79.2	78.8	77.8	76.7	75.1	72.8	71.1	70.3	69.3	68.0	72.3
Buffalo, N. Y.....	67.3	66.6	66.2	65.8	65.6	66.0	67.8	69.2	70.3	71.3	72.5	73.1	74.2	74.9	75.1	74.5	74.3	73.3	72.7	72.3	71.0	70.2	69.2	67.9	70.5
Cedar City, Utah....	71.2	70.2	69.2	68.5	67.2	66.5	65.3	65.6	66.4	70.0	74.3	77.4	79.6	81.5	81.8	82.4	82.4	82.4	81.5	80.5	79.3	76.8	74.0	72.7	74.4
Chicago, Ill.....	69.7	69.2	68.6	68.0	67.6	67.2	67.8	69.4	70.6	72.3	73.2	74.1	74.3	74.9	75.2	75.0	74.4	74.1	73.5	73.4	72.4	71.5	70.8	70.6	71.6
Cincinnati, Ohio....	72.5	71.2	70.4	69.5	68.3	67.5	67.9	71.3	73.7	76.7	79.0	80.9	82.6	83.7	84.7	85.3	85.6	85.1	83.7	80.8	79.3	77.1	75.4	73.9	76.9
Cleveland, Ohio	69.4	68.7	67.7	67.0	66.6	66.4	68.0	69.4	72.4	73.9	74.7	74.5	75.0	74.4	74.5	74.3	75.0	75.7	75.6	75.0	73.6	72.7	71.4	70.3	71.9
Detroit, Mich.....	68.4	67.7	66.8	66.0	65.0	64.6	65.3	67.8	70.0	71.7	72.9	74.4	75.6	76.7	77.3	77.7	78.1	78.1	77.1	75.1	73.2	71.5	70.4	69.2	71.7
Dodge, Kans.....	69.5	68.5	67.9	67.3	66.8	66.3	66.0	67.4	70.0	72.9	75.9	78.1	80.2	81.4	82.0	82.7	83.1	82.4	81.3	80.2	76.9	74.4	72.5	71.4	74.4
Eastport, Me.....	54.9	54.7	54.1	53.9	54.1	54.7	56.2	58.3	60.2	61.1	61.5	62.1	62.7	63.2	62.7	63.2	62.7	61.6	59.4	58.5	57.5	56.4	56.0	55.5	58.5
Galveston, Tex.....	81.6	81.3	80.9	80.6	80.5	80.1	80.2	80.5	81.6	82.9	84.1	85.2	85.5	86.1	86.1	85.9	85.4	85.0	84.5	83.7	82.6	82.5	82.1	81.9	83.0
Havre, Mont.....	64.3	62.3	60.7	59.3	57.9	56.8	55.2	56.5	59.8	63.0	66.8	70.3	73.8	75.7	77.2	78.6	79.6	80.1	80.1	79.4	78.1	74.8	69.4	66.9	68.6
Independence, Cal..	81.4	78.8	77.5	75.5	74.1	72.6	71.1	69.8	69.9	72.3	76.9	81.0	85.0	87.9	90.3	91.6	92.2	92.5	92.4	92.6	90.9	87.6	85.5	83.6	82.2
Kalispell, Mont	59.7	57.8	56.1	54.1	53.0	51.5	50.3	50.5	53.3	58.2	62.7	66.2	68.9	71.4	73.4	74.1	75.5	75.4	76.2	75.7	74.8	71.6	65.8	61.6	64.1
Kansas City, Mo.....	72.8	72.1	70.8	70.4	69.8	69.2	69.1	70.9	73.4	75.3	77.0	78.9	80.2	81.3	81.8	82.5	83.2	83.1	82.6	81.3	78.8	76.9	75.8	74.2	76.3
Key West, Fla.....	81.0	80.9	80.7	80.7	80.4	80.0	80.7	82.1	83.4	84.4	85.2	85.6	85.5	85.7	85.8	85.4	85.0	84.4	83.6	82.8	82.3	81.6	81.3	81.1	82.9
Marquette, Mich	60.6	60.3	59.7	59.3	58.7	58.7	59.8	62.3	64.2	65.8	67.6	67.7	67.5	67.4	67.2	67.2	67.1	66.8	65.4	64.9	63.2	61.9	61.2	61.1	63.6
Memphis, Tenn.....	76.0	75.3	74.7	74.1	73.5	73.0	73.1	74.6	77.0	78.9	81.3	83.1	84.3	85.4	85.9	85.9	85.6	84.7	83.3	82.3	80.3	79.5	78.0	77.0	79.4
Mt. Tamalpais, Cal..	70.4	70.1	69.5	68.6	68.4	68.4	67.9	67.6	66.9	67.4	68.6	70.3	70.7	71.5	72.6	73.6	74.0	74.8	75.3	74.5	73.3	72.9	71.3	70.9	70.8
New Orleans, La.....	78.5	78.4	78.0	77.7	77.8	77.3	77.3	79.0	81.2	82.5	83.8	84.9	86.1	86.7	86.9	85.2	85.6	85.5	83.7	83.2	81.6	80.5	79.5	79.1	81.7
New York, N. Y.....	69.3	68.7	68.1	67.5	67.0	67.8	69.0	70.3	72.2	74.8	76.4	77.9	78.8	79.5	79.7	79.4	78.7	77.3	75.4	73.9	72.7	71.9	71.1	70.7	73.3
Philadelphia, Pa.....	70.8	70.1	69.5	69.1	68.7	69.4	71.1	72.9	75.3	77.5	79.5	81.5	82.9	83.5	84.2	84.0	83.7	81.8	79.2	77.0	74.9	73.8	72.8	71.8	76.0
Pittsburg, Pa.....	69.5	68.7	68.0	67.1	66.7	67.1	68.4	70.6	74.3	77.1	79.4	80.9	82.2	83.0	83.8	83.0	82.8	81.3	79.3	77.9	74.5	73.4	71.9	70.6	75.1
Portland, Oreg.....	67.3	65.5	63.9	62.3	60.5	59.3	58.2	57.2	57.1	58.7	60.6	62.3	64.5	66.5	68.7	70.8	72.7	74.5	75.8	75.4	75.6	74.2	72.0	69.3	66.4
St. Louis, Mo.....	75.6	74.9	74.0	73.2	72.5	71.8	72.0	73.6	75.4	77.7	80.2	81.4	82.6	83.3	84.6	85.2	84.9	84.7	83.5	82.1	80.6	79.3	77.9	76.7	78.7
St. Paul, Minn.....	69.4	67.9	66.5	65.7	64.7	64.0	63.7	65.9	67.6	70.4	73.3	75.3	77.4	78.7	79.9	80.9	81.0	81.3	81.2	79.2	77.8	75.1	72.9	71.4	73.0
Salt Lake City, Utah.	73.9	72.9	70.8	68.7	67.8	66.3	65.3	66.3	68.1	70.9	74.9	78.8	81.5	83.9	85.4	86.3	86.8	87.1	86.5	85.5	84.3	80.1	76.5	74.9	76.8
San Diego, Cal.....	63.6	63.3	63.0	62.7	62.4	62.2	61.9	61.8	61.7	62.1	63.3	65.2	67.0	67.8	68.3	69.0	68.8	69.1	68.8	68.1	67.1	66.0	64.9	64.3	65.1
San Francisco, Cal...	53.0	52.6	52.1	51.7	51.4	51.2	51.0	51.5	51.0	51.6	53.0	55.7	57.2	58.7	59.3	59.6	59.9	59.2	58.5	57.1	56.4	55.1	54.1	53.4	54.8
Santa Fe, N. Mex ...	63.0	62.3	61.4	60.7	59.7	58.9	57.5	59.1	63.5	65.5	68.0	70.1	72.4	73.9	74.1	74.4	75.7	74.7	73.5	71.5	68.7	66.8	65.8	64.5	66.9
Savannah, Ga.....	75.9	75.5	75.1	74.9	74.4	74.3	75.4	77.8	81.5	84.1	86.5	87.8	87.2	86.7	86.1	85.0	83.4	82.2	80.8	79.5	78.5	77.8	77.1	76.6	80.2
Washington, D. C....	70.8	70.2	69.4	68.8	68.2	67.9	70.1	73.7	76.2	78.8	80.6	82.4	84.1	84.2	83.5	83.6	83.0	82.1	79.0	76.8	75.2	74.0	73.1	72.0	76.2
West Indies.																									
Basseterre, St. Kitts.	78.4	78.2	78.3	78.2	78.3	79.2	80.2	81.3	82.6	83.7	83.8	84.1	84.5	83.4	83.0	82.0	80.8	79.8	79.0	79.6	79.2	79.3	79.2	78.8	80.6
Bridgetown, Bar.....	77.0	76.6	76.6	76.6	76.8	78.7	81.5	82.3	83.3	84.3	85.1	84.8	84.7	84.2	83.1	82.4	80.8	79.6	79.0	78.8	78.5	78.1	77.9	77.5	80.3
Cienfuegos, Cuba ...	74.5	74.0	73.6	73.2	73.0	73.5	77.1	80.7	83.1	84.5	86.7	87.5	88.0	87.5	85.5	84.5	83.1	81.4	79.3	78.8	77.7	76.9	75.9	75.2	79.8
Havana, Cuba.....	76.9	76.5	76.1	75.6	75.2	75.0	76.5	79.5	82.7	85.0	86.0	86.1	85.6	85.0	84.7	83.8	83.1	82.3	81.5	80.9	80.1	79.3	78.5	78.0	80.6
Kingston, Jamaica ..	73.8	73.3	73.1	72.7	72.2	72.4	74.9	80.3	83.5	85.8	87.3	87.6	86.8	86.2	85.5	84.5	83.3	82.2	80.2	79.1	77.4	76.1	75.2	74.7	79.5
Port of Spain, Trin..	74.9	74.2	73.8	73.7	73.7	74.6	77.1	80.2	81.6	83.9	84.4	85.0	84.9	84.5	84.4	83.4	81.8	80.1	78.8	78.2	77.2	76.7	75.9	75.4	79.1
P. Principe, Cuba ...	73.7	73.2	72.6	72.4	72.1	72.1	75.0	78.2	81.1	84.0	86.0	88.5	90.0	89.5	87.5	85.0	83.6	81.6	79.7	77.9	76.5	75.7	74.9	74.2	79.4
San Juan, P. R.....	76.8	76.4	76.5	76.4	76.3	76.9	78.5	80.7	81.4	82.3	83.2	83.6	83.5	83.8	82.7	81.7	81.0	79.9	79.2	79.4	78.8	78.6	77.7	77.5	79.7
Santiago de Cuba...	76.3	75.8	75.4	75.1	74.6	74.9	78.1	80.7	85.2	86.8	88.3	88.6	88.5	88.0	87.2	85.2	83.9	82.7	81.3	80.5	79.6	78.7	77.9	76.9	81.2
Santo Domingo, S. D.	73.1	72.7	72.5	72.3	72.0	72.4	75.0	78.7	81.1	83.3	84.7	85.0	84.2	82.5	82.0	81.2	79.7	78.1	76.7	75.6	74.8	74.2	73.7	73.3	77.4
Willemstad, Curaçao	79.1	78.8	78.6	78.6	78.5	78.4	80.8	81.8	82.7	83.6	84.3	84.7	84.7	85.0	84.8	83.9	82.5	81.5	80.7	80.4	80.1	79.9	79.6	79.5	81.4

TABLE IV.—*Mean pressure for each hour of seventy-fifth meridian time, July*, 1899.

Stations.	1 a. m.	2 a. m.	3 a. m.	5 a. m.	4 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Mid'n't.	Mean.
Bismarck, N. Dak....	28.225	.229	.233	.235	.235	.240	.247	.251	.253	.252	.248	.245	.237	.227	.216	.206	.196	.187	.182	.180	.188	.197	.207	.215	.222
Boston, Mass.....	29.815	.810	.808	.811	.816	.826	.828	.829	.824	.823	.818	.810	.804	.798	.791	.784	.783	.787	.792	.802	.813	.816	.814	.811	.809
Buffalo, N. Y.....	29.139	.137	.137	.140	.147	.154	.159	.165	.164	.163	.159	.155	.144	.135	.127	.126	.115	.115	.117	.119	.128	.132	.133	.136	.139
Cedar City, Utah....	24.324	.323	.324	.323	.326	.330	.335	.341	.350	.357	.365	.365	.361	.355	.339	.329	.317	.302	.293	.287	.282	.285	.297	.312	.326
Chicago, Ill.....	29.119	.116	.116	.117	.125	.129	.136	.143	.145	.146	.146	.140	.135	.127	.119	.110	.102	.093	.090	.090	.097	.106	.108	.109	.119
Cincinnati, Ohio	29.346	.341	.338	.341	.346	.357	.364	.369	.372	.370	.368	.360	.348	.336	.319	.309	.305	.302	.310	.315	.327	.337	.338	.339	.340
Cleveland, Ohio	29.169	.165	.165	.171	.177	.186	.189	.193	.193	.195	.193	.191	.182	.174	.166	.160	.153	.150	.149	.150	.158	.160	.163	.165	.172
Detroit, Mich.....	29.195	.193	.191	.192	.197	.204	.210	.217	.222	.220	.218	.212	.204	.193	.182	.176	.168	.163	.165	.168	.178	.185	.187	.189	.193
Dodge, Kans	27.438	.436	.434	.434	.431	.433	.438	.441	.446	.450	.448	.446	.436	.425	.418	.401	.387	.379	.374	.381	.389	.400	.414	.422	.419
Eastport, Me	29.839	.835	.833	.836	.841	.847	.851	.855	.851	.851	.845	.841	.835	.830	.824	.823	.822	.821	.826	.834	.836	.838	.836	.835	.837
Galveston, Tex.....	29.917	.913	.908	.907	.911	.915	.926	.935	.949	.951	.952	.951	.946	.935	.920	.907	.897	.887	.883	.888	.894	.904	.915	.917	.918
Havre, Mont.....	27.365	.365	.364	.366	.374	.374	.381	.388	.396	.401	.401	.394	.388	.380	.370	.358	.348	.335	.323	.321	.327	.334	.345	.353	.365
Independence, Cal..	25.915	.925	.932	.935	.940	.942	.952	.965	.973	.978	.980	.979	.976	.966	.952	.935	.930	.902	.888	.874	.865	.868	.883	.898	.931
Kalispell, Mont	26.931	.937	.941	.948	.955	.959	.968	.976	.985	.989	.987	.980	.971	.959	.946	.936	.923	.909	.897	.880	.888	.891	.905	.916	.941
Kansas City, Mo.....	29.001	.999	.997	.996	.996	.000	.007	.018	.022	.029	.027	.023	.016	.008	.997	.985	.975	.965	.957	.962	.965	.974	.985	.992	.995
Key West, Fla.....	30.003	.995	.990	.988	.991	.997	.011	.017	.027	.030	.030	.025	.015	.003	.995	.985	.979	.977	.980	.989	.001	.007	.011	.010	.002
Marquette, Mich ...	29.161	.159	.160	.160	.162	.165	.166	.167	.169	.162	.155	.154	.152	.150	.148	.147	.144	.143	.144	.144	.151	.161	.159	.159	.156
Memphis, Tenn.....	29.570	.567	.564	.563	.569	.580	.593	.599	.609	.611	.614	.612	.602	.589	.576	.561	.546	.538	.539	.544	.552	.564	.569	.569	.575
Mt. Tamalpais, Cal .	24.507	.505	.501	.498	.493	.488	.488	.493	.502	.512	.525	.532	.540	.546	.549	.545	.539	.533	.519	.508	.499	.497	.499	.504	.513
New Orleans, La.....	29.940	.933	.931	.934	.939	.947	.960	.970	.978	.978	.977	.973	.968	.948	.935	.924	.913	.907	.906	.912	.920	.931	.940	.940	.942
New York, N. Y.....	29.642	.638	.636	.636	.643	.650	.655	.660	.660	.659	.654	.647	.639	.631	.620	.611	.607	.610	.615	.622	.635	.638	.640	.640	.637
Philadelphia, Pa.....	29.862	.858	.856	.856	.861	.869	.877	.883	.884	.882	.875	.867	.855	.845	.838	.830	.823	.826	.833	.839	.854	.857	.859	.859	.856
Pittsburg, Pa.....	29.110	.107	.105	.106	.109	.117	.123	.123	.122	.120	.116	.109	.099	.089	.082	.077	.075	.076	.085	.092	.104	.109	.109	.108	.103
Portland, Oreg.....	29.860	.868	.878	.882	.888	.891	.898	.896	.904	.909	.910	.907	.902	.895	.885	.872	.858	.846	.834	.823	.817	.817	.825	.841	.871
St. Louis, Mo.....	29.380	.378	.376	.378	.381	.392	.403	.408	.416	.413	.414	.410	.406	.390	.380	.366	.360	.351	.343	.352	.355	.369	.373	.376	.382
St. Paul, Minn.....	29.072	.071	.069	.069	.071	.078	.084	.091	.094	.093	.089	.088	.080	.076	.068	.059	.052	.045	.040	.036	.036	.047	.056	.060	.068
Salt Lake City, Utah.	25.604	.607	.607	.611	.614	.617	.629	.640	.651	.657	.662	.659	.655	.645	.633	.619	.602	.586	.575	.569	.568	.580	.591	.596	.616
San Diego, Cal.....	29.799	.799	.794	.788	.782	.778	.779	.785	.794	.802	.807	.809	.809	.807	.802	.796	.786	.779	.772	.766	.768	.774	.785	.796	.790
San Francisco, Cal...	29.798	.793	.790	.786	.781	.780	.781	.789	.797	.806	.816	.818	.821	.820	.815	.806	.795	.784	.772	.763	.765	.770	.776	.787	.792
Santa Fe, N. Mex ...	23.398	.398	.392	.389	.388	.389	.395	.402	.408	.414	.414	.412	.404	.392	.381	.371	.356	.349	.344	.343	.352	.365	.384	.393	.385
Savannah, Ga.....	29.935	.928	.925	.927	.936	.944	.954	.961	.964	.966	.959	.950	.938	.924	.911	.904	.899	.899	.905	.911	.925	.934	.938	.936	.932
Washington, D. C....	29.868	.865	.866	.867	.872	.883	.890	.897	.898	.897	.892	.885	.867	.856	.845	.838	.831	.834	.840	.845	.854	.860	.863	.865	.865
West Indies.																									
Basseterre, St. Kitts.	29.946	.938	.935	.935	.943	.956	.965	.971	.977	.975	.969	.961	.947	.939	.931	.926	.931	.940	.956	.967	.977	.977	.972	.958	.954
Bridgetown, Bar....	29.889	.885	.884	.887	.897	.905	.912	.918	.917	.913	.907	.895	.881	.871	.864	.862	.872	.883	.898	.914	.923	.922	.914	.901	.896
Cienfuegos, Cuba...	29.923	.910	.904	.907	.915	.924	.937	.942	.947	.945	.940	.933	.918	.905	.892	.888	.892	.902	.918	.930	.936	.943	.940	.933	.922
Havana, Cuba.....	29.942	.930	.921	.922	.927	.934	.943	.955	.959	.961	.960	.955	.944	.935	.922	.919	.916	.917	.925	.932	.944	.954	.955	.950	.938
Kingston, Jamaica..	29.660	.648	.643	.641	.644	.655	.665	.665	.666	.663	.652	.638	.621	.605	.593	.589	.595	.600	.628	.647	.663	.670	.672	.667	.641
Port of Spain, Trin..	29.850	.844	.841	.842	.851	.864	.881	.885	.887	.880	.867	.852	.832	.817	.806	.806	.816	.828	.845	.861	.873	.879	.874	.863	.852
P. Principe, Cuba ...	29.620	.609	.602	.600	.604	.615	.624	.632	.631	.632	.627	.617	.605	.587	.574	.570	.572	.587	.600	.614	.634	.635	.638	.631	.610
San Juan, P. R.....	29.904	.894	.892	.892	.902	.914	.922	.926	.931	.932	.927	.919	.907	.897	.887	.883	.887	.896	.909	.919	.930	.933	.926	.914	.910
Santiago de Cuba...	29.869	.860	.850	.851	.857	.867	.870	.877	.881	.881	.872	.862	.850	.837	.825	.824	.827	.832	.845	.863	.878	.887	.888	.881	.860
Santo Domingo, S. D.	29.934	.927	.923	.921	.930	.941	.953	.960	.960	.955	.945	.932	.918	.909	.898	.893	.901	.909	.924	.940	.953	.962	.960	.947	.933
Willemstad, Curaçao	29.817	.809	.802	.804	.809	.820	.832	.839	.844	.841	.831	.818	.794	.776	.754	.744	.745	.756	.785	.808	.825	.838	.842	.835	.807

TABLE V.—*Average wind movement for each hour of seventy-fifth meridian time, July, 1899.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Abilene, Tex.	6.1	6.6	6.9	6.8	7.2	6.5	5.2	5.4	7.6	9.4	9.7	9.5	9.4	8.9	8.3	8.6	9.5	10.2	9.9	9.3	7.7	6.4	5.9	5.9	7.8
Albany, N. Y.	5.4	5.2	5.6	5.3	5.5	5.6	6.2	7.4	8.4	9.1	9.5	9.9	10.4	11.0	11.4	11.1	11.4	10.3	8.6	7.7	6.7	6.0	5.5	5.7	7.9
Alpena, Mich.	4.9	4.9	4.8	5.2	5.1	5.6	5.8	6.1	6.6	7.2	7.8	7.5	8.2	8.6	8.5	8.1	7.8	7.0	6.1	5.5	4.9	4.8	4.9	4.7	6.3
Amarillo, Tex.	6.7	7.0	6.6	6.7	6.3	6.0	6.0	5.9	6.9	8.5	9.0	9.4	9.4	8.9	9.2	8.3	9.0	9.1	9.5	8.7	7.7	8.3	8.1	8.0	7.9
Atlanta, Ga.	7.5	7.5	7.7	8.0	7.8	7.3	7.1	6.9	7.1	7.4	7.5	7.9	8.5	8.7	8.8	8.6	8.7	8.4	8.1	7.7	7.0	7.0	7.3	7.7	7.8
Atlantic City, N. J.	8.8	8.9	8.3	8.6	8.7	8.2	9.2	10.1	10.2	11.1	11.7	11.7	11.9	12.5	12.4	11.7	11.5	10.7	10.4	9.3	9.1	9.3	9.3	8.8	10.1
Augusta, Ga.	3.6	3.6	3.6	3.1	3.0	3.0	3.3	4.5	5.5	6.3	6.6	6.7	7.0	7.3	8.0	7.5	7.5	7.2	5.9	5.2	4.1	4.1	4.1	3.5	5.2
Baker City, Oreg.	3.8	2.9	3.4	4.8	5.8	6.7	7.5	8.0	8.2	5.7	3.2	2.9	3.6	4.6	5.2	6.5	6.7	7.8	8.1	7.9	7.5	6.8	5.2	4.5	5.7
Baltimore, Md.	2.9	3.2	3.3	3.2	2.8	2.8	3.0	4.3	5.1	5.3	5.7	5.9	6.4	6.7	7.1	6.8	6.4	5.9	4.6	4.3	3.6	3.2	2.8	2.9	4.5
Bismarck, N. Dak.	6.6	6.9	5.7	6.0	4.9	5.1	5.0	5.3	6.1	7.1	8.6	9.2	10.0	10.4	10.4	10.4	10.6	10.5	10.1	9.3	7.5	6.4	5.9	6.5	7.7
Block Island, R. I.	12.5	12.9	12.1	11.8	12.2	12.8	13.0	13.9	14.1	14.0	14.7	15.5	15.5	16.2	16.5	17.1	16.5	15.5	14.3	13.9	14.1	14.4	13.4	13.1	14.2
Boise, Idaho	4.8	4.7	4.4	4.3	3.9	3.4	3.1	3.0	2.9	2.5	2.5	3.5	4.4	4.9	5.5	5.6	6.4	6.2	6.4	5.3	4.8	4.0	4.3	3.6	4.3
Boston, Mass.	8.8	8.9	8.8	8.7	8.7	8.9	9.5	9.7	11.2	12.1	12.8	13.8	13.4	14.2	14.2	14.0	13.5	12.5	11.4	10.1	10.0	10.2	9.7	9.3	11.0
Buffalo, N. Y.	10.2	10.3	10.5	10.6	10.3	9.5	8.8	9.4	9.8	10.7	11.6	12.7	13.5	14.4	14.4	14.3	14.5	13.6	13.3	10.9	11.4	10.6	10.7	10.8	11.5
Cairo, Ill.	4.0	4.3	4.2	4.1	4.4	4.5	4.5	4.9	5.2	5.9	6.2	7.0	6.5	7.6	7.1	7.3	7.5	7.0	5.9	4.9	4.8	4.4	4.2	4.1	5.4
Cape Henry, Va.	10.1	10.1	10.2	9.9	10.1	10.9	11.1	12.0	11.8	11.3	11.5	11.7	12.5	12.0	11.8	12.0	12.0	11.4	10.5	10.1	9.8	10.0	10.4	10.3	11.0
Carson City, Nev.	5.4	4.8	5.1	4.1	3.8	3.2	3.3	3.5	2.8	2.3	2.4	3.0	4.2	6.6	8.0	9.8	12.3	14.2	14.5	14.2	13.3	12.8	10.2	7.5	7.1
Cedar City, Utah.	6.9	7.2	7.3	7.3	7.1	7.5	8.0	7.7	7.0	5.0	3.9	3.5	5.2	5.9	6.6	7.5	8.1	8.9	8.8	7.7	6.6	5.9	4.8	5.9	6.7
Charleston, S. C.	10.2	9.8	9.5	9.7	8.9	8.7	9.3	10.6	11.5	12.4	13.0	13.5	14.5	15.6	16.4	16.6	16.0	15.7	13.8	11.5	10.7	10.0	10.2	10.2	12.0
Charlotte, N. C.	5.4	5.0	4.5	4.5	4.6	4.1	4.2	5.2	6.4	6.1	6.0	6.5	6.9	7.2	7.5	7.8	7.5	6.7	6.5	5.7	5.5	5.5	4.9	4.6	5.8
Chattanooga, Tenn.	3.3	3.5	3.4	3.4	3.5	3.5	3.8	4.4	5.3	5.9	6.2	6.8	7.5	7.4	7.9	7.9	8.3	8.8	7.6	5.7	4.6	4.5	3.7	3.2	5.4
Cheyenne, Wyo.	8.5	7.3	6.0	5.5	5.8	6.1	6.2	5.8	5.9	6.8	8.0	9.1	10.6	11.2	12.0	11.0	11.2	11.8	11.3	11.9	11.0	8.7	7.3	7.6	8.6
Chicago, Ill.	10.4	10.9	11.3	11.5	11.8	11.5	10.5	11.6	11.8	12.5	13.1	13.9	14.7	15.3	14.4	14.5	14.0	13.2	12.0	12.3	11.3	11.2	11.2	10.8	12.3
Cincinnati, Ohio.	3.1	3.1	3.5	3.4	3.1	3.0	3.6	4.1	5.7	7.0	8.4	8.6	8.5	8.5	10.2	9.6	9.6	9.2	8.5	7.5	4.7	4.2	3.6	3.5	6.0
Cleveland, Ohio.	11.3	11.9	11.9	10.9	10.2	10.3	10.3	10.5	10.2	10.6	10.9	11.4	11.5	12.0	12.9	11.9	11.5	10.6	10.4	9.2	9.7	10.4	11.0	11.5	11.0
Columbia, Mo.	4.4	4.0	4.1	4.8	4.4	5.0	4.7	4.7	5.2	5.5	6.2	6.4	6.6	6.6	7.4	7.1	6.2	6.0	5.2	4.3	4.1	4.3	4.6	4.1	5.2
Columbus, Ohio.	4.3	3.7	3.8	3.5	3.2	3.2	3.9	4.9	5.4	6.2	7.5	7.8	8.3	8.5	9.3	9.6	9.5	8.7	7.5	5.9	5.3	5.5	5.1	4.5	6.0
Concordia, Kans.	3.6	3.8	3.4	3.7	3.2	2.5	2.6	3.1	4.1	5.2	5.8	5.8	6.0	6.1	6.1	6.1	5.6	5.5	5.1	4.2	3.6	3.7	3.6	4.2	4.4
Corpus Christi, Tex.	12.9	10.8	9.5	8.4	7.2	6.9	6.1	5.7	7.7	9.4	10.0	11.4	13.9	15.1	16.3	16.9	17.8	17.4	18.0	17.4	16.9	16.8	15.7	14.2	12.6
Davenport, Iowa.	3.7	4.2	4.2	4.6	4.4	4.1	4.5	4.9	5.5	6.2	6.5	6.8	7.3	7.8	7.6	7.5	6.9	6.8	6.8	5.4	3.6	3.3	3.5	3.4	5.4
Denver, Colo.	7.2	6.7	6.6	7.2	7.2	6.3	5.8	5.4	5.3	5.4	6.0	6.6	6.8	7.2	7.3	8.1	9.6	11.5	10.1	9.3	8.3	8.6	8.1	7.4	7.4
Des Moines, Iowa.	3.9	4.0	3.5	3.3	3.1	3.1	3.1	3.9	5.6	6.0	6.9	7.5	7.5	7.6	7.9	7.8	8.3	7.8	7.2	6.2	4.7	4.1	4.2	3.9	5.5
Detroit, Mich.	6.1	6.0	5.8	6.1	6.3	6.0	6.1	6.2	6.5	7.6	8.8	9.4	10.0	10.6	10.7	11.0	10.6	9.7	8.4	7.0	5.8	6.0	6.3	6.2	7.6
Dodge, Kans.	7.1	6.2	6.0	6.1	6.0	6.4	5.9	6.5	8.0	9.6	9.9	10.4	10.5	11.0	11.2	11.1	10.9	11.0	12.0	10.6	8.0	7.3	7.3	7.4	8.6
Dubuque, Iowa.	3.7	3.2	3.7	4.0	4.1	3.8	4.1	4.6	5.5	6.5	7.5	7.4	7.9	7.7	7.9	7.9	8.1	7.8	6.8	5.8	4.7	4.7	4.0	4.1	5.6
Duluth, Minn.	9.1	8.9	9.2	8.5	9.2	8.4	8.0	7.9	7.6	8.0	9.1	9.5	10.5	10.2	9.8	10.1	10.0	9.6	8.1	8.1	8.4	8.3	8.1	8.3	8.9
Eastport, Me.	6.5	6.5	5.7	5.6	6.0	5.7	6.6	8.0	8.0	8.8	9.8	10.6	10.7	10.9	11.0	11.0	10.0	9.0	8.3	6.9	7.0	7.6	7.3	6.4	8.1
Elkins, W. Va.	1.5	1.5	1.5	1.4	1.4	1.6	1.6	2.1	2.9	3.7	4.8	5.7	6.0	6.0	5.9	5.6	4.7	4.4	3.5	2.5	1.9	1.8	1.6	1.8	3.1
El Paso, Tex.	10.9	10.3	9.7	10.1	10.3	10.2	9.9	8.9	8.5	9.4	10.0	9.4	8 8	9.0	8.7	10.0	10.7	11.1	10.3	11.3	10.5	9.6	9.7	9.8	9.9
Erie, Pa.	8.9	8.9	8.9	8.5	8.2	8.1	8.1	8.5	8.7	9.0	10.0	10.5	10.3	10.2	10.3	10.3	10.5	9.4	7.8	7.8	7.8	8.4	9.4	9.4	9.1
Escanaba, Mich.	6.4	6.0	6.0	6.2	6.3	5.7	6.4	6.5	7.0	8.5	9.4	10.3	10.3	10.5	11.3	10.6	11.2	10.3	9.1	8.0	7.1	6.6	6.7	6.3	8.0
Eureka, Cal.	5.7	5.7	4.8	4.4	4.3	3.8	3.4	2.6	2.7	2.8	3.0	4.2	5.1	5.7	7.2	8.4	8.7	11.1	11.5	11.0	10.6	9.4	8.1	7.0	6.3
Evansville, Ind.	3.6	3.5	3.6	3.8	4.0	4.0	4.5	4.5	5.3	5.7	6.7	7.2	7.4	7.8	7.8	7.7	7.8	6.3	5.4	4.6	3.5	3.5	3.4	3.9	5.2
Fort Canby, Wash.	8.3	7.5	7.1	6.6	6.2	6.0	6.8	6.5	6.5	6.7	6.7	6.7	7.3	8.1	8.5	8.2	8.8	9.2	8.9	8.6	8.1	8.8	8.7	8.0	7.6
Fort Smith, Ark.	3.4	3.2	3.7	3.8	3.5	3.4	3.6	3.8	4.1	4.5	5.2	5.5	5.5	6.3	6.5	6.7	6.9	6.7	5.1	4.5	3.0	3.7	3.9	3.5	4.6
Fresno, Cal.	9.9	9.9	9.8	8.5	7.5	6.5	5.5	4.2	3.7	2.9	3.1	3.8	4.2	4.4	4.6	5.3	5.6	5.9	6.6	6.7	7.5	8.6	8.2	9.0	6.3
Galveston, Tex.	7.3	7.5	7.6	7.4	7.4	7.2	6.8	6.9	8.1	8.9	9.0	8.6	8.5	8.9	8.8	8.4	8.5	8.5	8.3	8.0	7.8	7.1	6.9	7.1	7.9
Grand Haven, Mich.	6.0	6.4	6.2	5.9	5.6	6.1	5.9	6.4	6.9	7.7	8.5	9.5	10.0	10.0	9.5	9.2	8.5	7.8	6.6	6.1	5.3	5.1	5.4	5.6	7.1
Grand Junction, Colo.	4.5	3.9	3.7	3.7	3.8	4.1	4.0	3.9	4.7	6.2	7.0	6.5	5.1	5.0	5.1	5.1	5.2	5.9	7.9	8.7	6.7	5.1	4.7	4.7	5.2
Green Bay, Wis.	4.9	4.3	4.8	5.3	4.8	4.9	5.2	5.9	6.7	7.7	7.8	8.5	8.5	8.5	8.7	8.7	8.3	7.7	7.5	6.5	5.2	4.9	5.3	4.9	6.5
Hannibal, Mo.	4.7	4.6	4.5	4.5	4.7	5.2	5.4	5.5	6.0	6.8	7.2	7.8	9.0	8.6	8.7	8.5	7.8	6.9	6.4	5.5	3.8	3.2	3.6	4.2	6.0
Harrisburg, Pa.	4.0	4.1	4.5	3.8	3.9	4.0	4.5	4.9	5.3	5.6	6.2	7.1	7.4	7.1	6.7	6.7	7.4	6.1	6.2	5.3	5.2	4.5	4.1	3.8	5.4
Hatteras, N. C.	11.2	10.5	9.9	10.3	11.4	11.3	11.8	12.6	12.6	13.9	13.6	13.9	14.0	14.1	13.9	13.9	13.5	12.7	12.1	11.4	11.4	10.9	11.5	11.4	12.2
Havre, Mont.	5.5	5.5	5.4	5.1	4.8	5.6	5.5	5.6	6.6	7.8	8.5	8.9	9.7	10.2	10.2	10.9	10.6	9.8	9.6	9.2	7.9	7.5	6.8	6.9	7.7
Helena, Mont.	9.6	9.8	9.3	8.1	7.9	8.6	8.3	8.6	4.6	4.0	4.9	5.3	6.0	6.6	7.4	7.5	7.6	8.4	9.1	8.7	9.6	7.7	7.9	9.2	7.7
Huron, S. Dak.	9.3	8.8	7.9	8.3	8.4	7.9	7.6	7.8	9.2	10.6	12.2	12.7	12.5	13.2	13.7	14.1	14.0	13.8	13.4	12.5	10.3	9.0	8.7	9.2	10.6
Independence, Cal.	6.7	6.4	5.4	5.8	5.0	5.5	5.3	5.0	5.3	5.1	5.8	5.4	6.1	6.9	9.1	11.1	12.8	13.4	12.2	12.0	11.9	9.8	8.9	8.3	7.9
Indianapolis, Ind.	4.9	5.3	5.3	5.8	5.6	4.9	5.3	5.8	6.7	8.5	9.4	10.1	10.4	10.4	10.4	10.9	10.4	9.8	9.6	8.0	6.3	6.4	6.2	5.6	7.6
Jacksonville, Fla.	6.2	6.7	6.9	6.8	6 5	5.9	6.0	6.5	7.1	7.5	7.3	7.5	7.1	8.3	9.4	9.8	9.6	8.7	8.2	7.1	7.1	6.8	6.7	6.5	7.3
Jupiter, Fla.	7.1	6.9	6.9	6.2	6.3	6.4	6.3	6.8	8.1	9.4	9.9	10.0	11.7	12.5	12.4	11.7	11.7	10.2	9.0	8.0	7.6	7.6	7.4	7.3	8.6
Kalispell, Mont.	6.3	6.5	6.5	6.6	6 2	6.2	6.4	6.0	5.9	5.2	4.5	4.2	5.2	5.0	5.8	6.9	7.5	7.7	7.5	7.6	6.9	5.8	5.7	6.0	6.2
Kansas City, Mo.	5.1	5.3	5.1	5.0	4.5	4.5	4.5	4.9	5.7	6.6	7.0	7.4	7.8	7.6	7.9	7.5	7.4	7.2	6.6	5.3	4.7	4.7	5.0	5.4	6.0
Keokuk, Iowa.	3.8	4.3	3.8	3.9	3.7	4.1	4.8	5.0	5.6	6.2	6.5	7.1	7.2	7.3	7.7	7.6	7.1	6.6	5.6	4.4	3.3	3.7	3.5	4.1	5.3
Key West, Fla.	6.5	5.7	5.8	5.5	5.2	5.5	5.8	6.9	7.5	8.1	8.3	8.3	9.0	8.5	8.2	8.4	7.5	7.4	6.9	6.5	6.4	6.7	6.9	6.5	7.0
Kittyhawk, N. C.	11.5	12.3	12.2	11.7	11.8	11.3	12.2	12.5	13.0	12.9	11.6	12.3	12.9	14.1	14.7	14.7	14.0	13.6	13.7	12.8	12.8	12.9	12.4	11.6	12.7
Knoxville, Tenn.	4.7	4.0	3.6	3.9	4.0	4.1	3.9	4.5	5.6	5.6	6.2	6.3	7.2	7.4	6.9	6.8	6.4	6.2	6.5	5.2	5.0	4.9	4.7	4.6	5.3
La Crosse, Wis.	3.6	4.5	4.2	3.6	3.7	3.9	4.2	4.4	5.1	4.8	5.8	5.9	6.9	7.3	7.2	7.0	7.1	6.8	6.3	5.1	4.6	4.1	3.4	3.4	5.1
Lander, Wyo.	5.3	5.0	4.4	3.8	3.4	3.2	3.1	2.5	2.4	2.5	3.1	3.1	4.0	5.7	6.1	6.7	6.9	6.5	7.2	6.6	4.8	4.2	5.7	5.6	4.7
Lexington, Ky.	6.6	6.2	6.3	5.7	5.7	6.8	6.7	6.3	7.4	8.1	8.7	9.2	9.5	9.8	10.6	10.8	10.8	9.8	8.6	8.4	7.2	6.8	6.5	6.7	7.9
Little Rock, Ark.	3.0	3.7	3.8	3.9	3.9	4.0	4.7	5.0	5.3	6.4	6.4	6.7	7.3	7.5	7.8	7.7	7.7	7.5	7.3	5.7	4.9	4.3	4.2	3.8	5.5
Los Angeles, Cal.	2.4	1.9	1.7	1.5	1.3	1.3	1.2	1.2	1.5	1.6	2.3	3.2	4.2	5.4	6.9	8.2	8.9	9.1	8.9	8.3	7.2	6.1	4.7	3.1	4.3
Louisville, Ky.	3.1	3.3	3.2	3.2	3.6	3.5	3.7	4.3	4.6	5.0	5.7	5.9	6.8	7.6	7.3	7.1	7.1	6.7	6.2	4.8	3.7	3.7	3.6	3.5	4.9
Lynchburg, Va.	1.5	1.3	1.5	1.1	1.0	0.9	1.4	2.2	3.3	3.5	4.3	4.5	5.2	5.4	5.2	5.4	5.2	4.6	3.7	3.0	2.1	1.5	1.4	1.6	2.9
Macon, Ga.	2.9	2.6	3.0	2.8	2.3	2.7	2.8	4.2	5.0	6.3	6.9	6.9	7.4	7.9	7.9	7.8	7.5	7.5	6.6	4.8	4.8	4.1	3.5	3.1	5.1
Marquette, Mich.	7.5	8.0	8.0	8.5	8.0	7.4	7.4	8.4	8.2	8.8	8.5	9.2	8.5	9.4	9.3	8.7	8.2	7.8	6.4	5.9	5.2	5.8	6.6	7.3	7.8
Memphis, Tenn.	4.6	4.2	4.4	4.2	4.2	4.2	4.2	4.7	4.6	4.7	5.1	5.2	5.3	6.4	6.7	6.8	6.4	6.5	5.7	4.9	4.5	4.2	4.7	4.5	5.0
Milwaukee, Wis.	7.0	6.9	6.7	6.6	6.5	6.8	7.0	7.1	8.1	8.8	10.0	11.1	11.5	11.7	11.9	10.8	10.1	9.5	8.8	7.4	6.0	6.4	6.5	6.5	8.3
Minneapolis, Minn.	7.1	7.2	6.1	6.5	6.8	6.6	6.5	6.4	6.7	7.1	7.7	7.7	8.0	8.2	8.1	8.6	8.9	8.7	8.5	7.6	6.9	7.2	7.1	7.4	7.4
Mobile, Ala.	3.0	3.1	3.3	3.2	3.3	3.2	3.2	3.6	4.8	5.1	5.7	6.1	7.1	7.9	8.2	8.8	9.2	8.9	7.2	5.4	4.8	3.8	3.9	3.8	5.3
Montgomery, Ala.	4.5	3.9	3.7	3.9	3.5	4.0	3.5	4.1	5.2	5.2	5.5	6.1	6.6	7.0	7.6	7.9	8.8	8.4	7.7	5.7	5.2	5.1	5.0	4.8	5.5
Moorhead, Minn.	7.4	7.3	7.1	6.9	6.6	6.3	6.2	6.8	7.9	8.5	9.0	9.2	9.2	9.8	10.0	10.1	10.5	9.8	9.2	9.1	7.6	7.0	7.3	7.5	8.2
Mount Tamalpais, Cal.	25.9	24.9	23.8	24.0	23.6	23.2	23.3	21.9	20.0	19.0	16.1	13.9	12.2	9.8	8.0	7.1	7.2	8.8	11.2	14.2	18.0	19.5	22.8	24.6	17.6
Nantucket, Mass.	8.1	8.5	8.5	8.3	8.1	8.5	9.2	10.1	10.9	11.5	11.7	12.1	11.5	12.3	12.3	12.1	11.7	11.0	9.5	9.2	9.1	8.8	8.8	8.8	10.0
Nashville, Tenn.	3.7	3.4	2.9	2.8	2.7	2.8	2.8	3.9	4.7	6.0	6.6	7.0	7.8	8.1	8.1	8.2	8.2	8.3	7.7	7.2	5.5	5.7	4.8	4.2	5.6
Neah, Wash.	6.2	5.9	5.7	5.4	5.2	4.8	4.6	4.4	4.0	4.0	4.9	6.0	6.6	7.5	9.1	9.8	10.7	11.1	10.5	10.2	9.9	8.8	8.1	6.8	7.1

TABLE V.—*Average wind movement, etc.*—Continued.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
New Haven, Conn....	5.0	4.8	4.7	4.3	4.8	4.7	5.7	6.7	8.2	8.5	9.9	9.6	10.2	10.0	10.5	10.4	10.0	9.3	7.2	6.7	6.2	5.6	5.4	4.9	7.2
New Orleans, La.....	4.6	4.4	4.4	3.8	4.0	4.0	4.1	4.8	6.6	7.7	7.8	7.7	8.3	7.8	8.8	8.3	7.6	7.3	7.5	6.0	5.3	5.6	5.2	4.9	6.1
New York, N. Y.....	11.1	10.5	11.1	11.2	11 2	10.6	11.0	11.2	11.3	11.5	12.1	13.1	13.2	14.5	15.4	15.8	16.2	15.6	15.8	14.4	13.2	12.4	10.8	11.4	12.7
Norfolk, Va.....	7.7	7.6	7.3	7.0	7.0	6.9	7.5	8.2	8.9	9.0	8.5	9.4	9.7	9.4	10.2	10.4	10.8	10.1	9.6	8.1	8.5	8.1	8.0	7.8	8.6
Northfield, Vt.....	6.2	5.8	5.5	5.1	5.5	5.5	5.6	6.5	7.8	9.9	10.5	10.8	11.6	11.2	11.8	11.0	10.1	9.4	6.9	6.2	6.3	6.7	6.3	6.3	7.9
North Platte, Nebr...	8.0	6.8	7.0	6.1	5.7	5.2	5.2	5.8	7.1	8.9	8.8	8.9	9.3	9.8	9.6	9.5	9.8	9.6	10.5	9.6	8.6	8.2	8.6	8.3	8.1
Oklahoma, Okla.....	5.8	6.2	6.0	6.0	5.5	5.7	4.6	5.4	6.8	7.9	8.8	9.0	9.5	9.2	9.1	9.2	9.3	9.0	8.5	8.5	6 9	6.2	6.4	6.5	7.8
Omaha, Nebr.....	4.2	4.5	4.7	4.7	4.5	4.2	4.3	5.1	5.8	6.2	7.2	8.0	8.4	8.7	9.2	8.9	8.9	8.6	7.7	7.8	6.7	5.5	5.0	4.5	6.4
Oswego, N. Y.....	8.5	7.9	8.1	7.3	7.6	7.5	7.9	8.2	9.0	9.5	10.1	9.7	9.9	10.2	9.6	9.2	8.5	8.2	7.9	7.2	7.5	8.2	8.8	8.3	8.5
Palestine, Tex.....	4.3	4.3	4.5	4.6	4.0	3.9	3.7	4.1	5.5	6.4	6.8	6.6	6.5	6.6	6.9	7.8	6.9	6.9	6.0	4.8	3.5	3.4	3.9	4.2	5.2
Parkersburg, W. Va..	3.0	3.0	2.9	3.2	3.3	2.9	2.9	3.5	4.1	4.7	5.5	5.5	6.6	6.8	6.7	7.7	6.2	6.2	4.8	4.2	3.1	3.3	3.4	3.5	4.5
Pensacola, Fla.....	6.2	6.0	6.5	6.6	6.1	6.1	6.2	6.2	6.3	7.0	7.7	7.9	8.3	9.9	10.6	11.7	11.4	10.4	9.4	8.6	6.9	5.8	5.2	5.8	7.6
Phenix, Ariz.....	5.3	4.7	4.4	4.2	3.7	3.6	3.7	3.5	3.2	3.6	4.7	4.3	3.9	4.4	4.6	4.9	5.5	5.3	5.5	6.1	6.7	5.6	5.2	5.5	4.7
Philadelphia, Pa.....	8.5	8.0	8.1	8.1	7.5	7.3	7.7	9.1	10.3	9.6	10.5	10.9	11.4	11.5	12.1	12.0	12.1	12.4	10.8	9.7	8.9	8.3	8.3	8.5	9.6
Pierre, S. Dak.....	10.2	9.8	9.0	6.8	5.9	6.0	6.7	6.6	8.3	8.4	9.2	9.4	9.5	9.8	11.1	11.5	12.9	12.7	13.4	13.2	12.2	11.7	12.3	11.6	9.9
Pittsburg, Pa.....	3.2	2.9	2.9	3.0	3.0	3.2	3.4	4.2	4.5	5.0	5.3	5.5	5.7	5.6	5.5	5.7	5.5	5.9	5.4	4.7	4.2	3.9	3.8	3.3	4.4
Pocatello, Idaho.....	9.5	10.6	10.3	12.0	11.0	10.8	10.5	9.0	8.6	8.7	8.8	9.9	10.0	10.6	10.1	11.3	12.3	12.9	13.3	12.2	11.2	9.7	9.2	9.3	10.5
Point Reyes Lt., Cal..	22.9	22.1	22.9	22.4	21.9	21.7	21.1	20.5	19.1	18.8	18.6	17.7	18.0	17.6	17.9	18.7	19.2	20.3	21.3	22.1	22.3	21.7	22.6	22.7	20.6
Port Crescent, Wash.	4.3	4.2	4.0	4.1	3.8	3.5	3.3	2.9	3.5	3.8	4.7	6.2	6.7	7.3	7.7	7.8	8.0	8.1	7.6	7.9	8.1	7.6	6.1	5.2	5.7
Port Huron, Mich....	7.0	7.1	7.5	7.1	6.7	7.5	7.5	7.5	8.5	9.5	10.1	10.5	11.9	12.9	13.6	13.2	12.6	10.8	10.1	8.4	7.4	6.6	6.3	6.1	9.0
Portland, Me.....	5.0	5.4	5.0	4.5	4.4	5.0	5.2	6.3	6.7	7.3	8.5	9.6	10.2	11.3	11.6	11.3	10.1	9.4	7.7	6.7	6.2	5.6	5.1	5.6	7.2
Portland, Oreg.....	10.1	8.9	7.1	5.7	4.5	3.7	3.7	4.0	3.5	4.3	5.9	6.5	7.5	7.3	7.1	7.9	8.4	8.5	9.0	9.9	10.0	9.8	9.4	10.0	7.2
Pueblo, Colo.....	5.1	4.7	5.1	3.9	4.5	5.0	4.3	4.3	4.6	5.3	5.4	6.5	7.3	8.8	9.5	11.2	11.1	11.4	10.7	9.0	8.8	7.5	6.2	4.9	7.0
Raleigh, N. C.....	3.9	3.5	3.6	3.5	3.3	3.5	3.8	4.9	5.7	5.6	5.9	6.1	6.3	6.8	7.1	6.4	6.0	5.3	4.5	4.2	4.0	3.9	4.3	4.3	4.9
Rapid City, S. Dak...	4.2	4.0	3.8	3.8	4.1	3.8	3.5	3.5	3.4	4.2	5.0	5.2	6.0	5.9	6.4	6.4	5.7	5.5	5.5	5.3	5.7	4.2	4.3	4.1	4.7
Red Bluff, Cal.....	4.9	5.5	4.9	4.4	3.6	3.8	3.0	3.1	3.0	3.3	4.2	4.9	5.0	4.8	5.1	6.1	6.6	7.3	7.1	6.8	6.5	6.5	6.1	5.7	5.1
Richmond, Va.....	3.7	4.1	4.1	3.9	3.6	3.7	4.3	5.2	6.0	6.5	6.8	7.0	7.4	7.5	7.4	8.0	7.9	7.5	7.0	6.3	5.1	4.6	4.2	4.2	5.7
Rochester, N. Y.....	5.1	5.6	5.3	5.0	5.0	5.1	5.4	6.0	6.8	7.1	7.6	8.3	9.2	9.6	9.4	9.3	8.9	8.3	7.3	6.2	5.4	5.5	5.5	5.5	6.8
Roseburg, Oreg.....	3.3	2.3	2.3	2.0	2.0	2.0	2.0	1.8	1.8	2.2	2.7	3.3	3.5	4.1	5.2	6.0	6.5	8.6	8.5	9.6	9.8	9.2	6.4	5.3	4.6
Sacramento, Cal.....	9.7	9.5	10.2	10.3	10.2	9.7	9.1	9.0	8.4	7.6	7.1	7.1	7.1	7.5	7.7	8.5	9.7	9.6	10.4	11.1	11.1	10.9	10.8	10.4	9.3
St. Louis, Mo.....	5.9	5.9	5.8	5.7	5.7	5.9	5.6	5.9	7.0	7.4	8.0	8.5	8.8	8.9	8.8	8.7	9.0	8.6	8.4	6.9	6.2	5.9	5.9	5.9	7.1
St. Paul, Minn.....	4.6	4.3	4.3	4.0	4.2	4.1	4.1	5.0	5.6	6.4	7.7	8.2	8.5	9.3	9 2	9.0	9.7	8.9	8.2	7.8	5.8	5.8	5.3	5.2	6.5
Salt Lake City, Utah.	5.2	5.3	5.8	4.5	4.3	4.2	4.3	4.0	3.1	2.8	3.5	4.7	6.6	6.6	7.9	8.7	8.3	8.4	7.3	7.3	6.1	7.2	7.5	6.5	5.8
San Antonio, Tex.....	7.5	6.4	5.6	5.3	4.8	4.8	4.3	4.4	5.5	7.2	7.5	7.5	7.9	8.1	8.5	8.8	10.1	10.5	10.5	11.0	10.0	10.5	10.0	9.0	7.7
San Diego, Cal.....	2.6	2.4	2.0	2.5	3.0	2.8	2.7	2.5	2.9	3.1	3.5	5.5	7.8	9.2	10.5	10.6	10.6	10.5	10.1	9.4	8.5	6.6	5.3	3.5	5.8
Sandusky, Ohio.....	5.8	6.3	6.1	5.8	5.5	5.5	6.1	6.3	6.9	7.0	7.4	8.0	8.8	8.5	8.1	7.8	7.4	7.0	6.6	5.4	4.9	5.2	5.2	5.5	6.5
Sandy Hook, N. J.....	14.8	13.6	13.3	13.8	14.0	13.3	12.5	13.1	11.9	11.7	12.7	12.9	13.6	13.4	15.1	14.8	15.4	15.3	15.5	16.2	15.1	16.0	16.2	15.5	14.2
San Francisco, Cal...	14.0	13.4	12.0	11.1	10.8	10.0	9.4	9.0	8.4	8.6	9.5	9.5	10.6	13.0	17.1	20.3	22.9	24.2	25.3	25.9	25.0	22.2	18.3	16.0	15.3
San Luis Obispo, Cal.	3.0	2.8	2.7	2.6	2.6	3.0	3.0	3.7	3.7	4.0	3.6	3.9	4.7	4.9	6.5	7.3	7.4	7.5	7.4	7.1	5.9	5.2	4.2	3.6	4.6
Santa Fe, N. Mex.....	6.2	5.3	4.3	3.7	3.1	2.6	2.4	2.5	1.9	2.7	3.6	4.7	5.5	6.9	7.5	8.6	7.5	8.3	7.9	8.2	7.6	7.0	6.5	6.4	5.5
Sault Ste. Marie, Mich	5.2	5.3	5.6	5.4	5.5	4.7	5.1	6.2	7.0	7.9	9.1	10.6	11.0	11.7	11.4	12.2	11.9	11.9	10.7	8.9	7.7	6.8	6.0	5.7	8.1
Savannah, Ga.....	5.9	6.5	6.3	6.0	6.0	6.1	6.0	6.8	7.5	7.7	7.8	8.5	10.3	10.9	11.8	12.5	12.2	11.6	10.0	8.6	7.7	7.2	7.1	6.2	8.2
Seattle, Wash.....	3.2	3.5	3.4	3.4	3.4	2.9	2.4	2.7	2.5	3.1	3.8	4.5	4.9	5.6	5.7	6.5	7.1	7.5	7.8	7.1	6.9	6.0	5.0	4.3	4.7
Shreveport, La.....	3.9	3.8	3.5	3.5	3.3	3.2	3.0	3.8	5.3	5.5	5.6	6.0	6.6	7.0	6.8	6.9	6.7	7.1	6.6	5.0	4.6	3.6	3.5	3.9	5.0
Sioux City, Iowa.....	7.3	7.2	6.6	6.3	6.8	7.3	6.6	6.8	7.2	8.4	10.2	10.8	11.6	12.3	13.4	13.4	12.6	12.0	11.1	10.2	9.5	9.5	9.3	8.2	9.4
Spokane, Wash.....	4.2	4.1	4.0	4.4	4.6	4.5	4.5	4.3	4.7	6.1	6.4	6.8	7.0	6.7	7.0	7.9	8.0	7.7	8.1	7.7	7.7	7.3	5.9	4.6	6.0
Springfield, Ill.....	5.0	5.1	5.3	5.1	5.2	4.9	5.0	5.7	6.4	7.2	7.5	7.8	8.0	8.7	9.0	9.3	8.9	8.5	7.7	6.4	4.9	5.0	4.6	5.1	6.5
Springfield, Mo.....	5.9	6.0	6.0	6.0	5.8	6.1	6.3	5.8	6.6	7.8	8.3	8.5	8.5	9.1	9.0	8.6	8.4	8.1	8.4	6.6	5.9	6.0	5.7	6.1	7.1
Tacoma, Wash.....	5.5	5.0	4.2	3.6	3.1	2.7	2.7	2.7	3.0	2.8	3.8	4.9	5.9	6.7	7.4	8.0	8.4	7.7	7.7	7.3	7.3	6.6	6.3	6.3	5.4
Tampa, Fla.....	3.9	4.3	4.6	4.7	4.3	4.4	4.3	5.3	5.9	6.3	6.5	6.7	6.8	7.1	7.1	7.3	8.7	8.1	6.7	5.2	4.6	4.6	5.0	4.7	5.7
Toledo, Ohio.....	5.8	5.9	6.0	5.5	5.6	5.6	6.0	6.5	6.9	7.5	8.4	9.0	9.3	10.1	10.7	10.6	9.7	8.8	7.4	6.0	5.7	5.6	5.4	5.5	7.2
Vicksburg, Miss.....	4.6	4.3	4.4	4.4	4.3	4.1	3.9	4.1	4.3	4.8	5.3	5.2	5.5	5.8	5.7	5.5	5.4	5.5	4.7	4.5	3.7	4.0	4.1	4.5	4.7
Vineyard Haven, Mass	7.9	7.9	7.3	7.1	8.0	7.5	8.2	9.0	9.5	9.9	9.6	10.2	10.2	11.4	11.3	11.4	10.9	10.1	9.2	8.6	8.4	8.6	8.8	7.8	9.1
Walla Walla, Wash...	6.1	5.5	5.6	6.1	5.4	5.0	5.3	5.3	5.2	5.4	5.9	6.6	6.3	5.9	6.0	6.6	6.4	6.7	6.9	6.8	6.8	5.8	5.4	6.1	6.0
Washington, D. C.....	4.1	4.2	4.0	3.9	3.6	3.3	3.6	5.2	5.8	6.1	6.8	7.2	8.0	8.4	8.5	8.3	8.0	6.9	6.2	4.9	4.3	4.1	4.3	3.9	5.6
Wichita, Kans.....	4.9	4.9	4.7	4.8	4.5	4.5	5.0	5.4	5.7	6.3	6.4	6.2	6.8	6.9	7.5	7.6	7.6	7.0	6.9	5.9	4.8	4.8	5.2	5.0	5.8
Williston, N. Dak.....	6.6	5.8	5.3	4.7	4.7	5.0	4.7	5.0	6.5	7.8	8.8	9.3	9.7	10.4	9.8	9 9	9.8	10.6	10.5	9.7	8.1	7.2	7.5	6.6	7.6
Wilmington, N. C.....	7.0	6.8	6.9	6.6	6.5	6.5	6.8	8.2	9.4	9.8	10 0	10.4	10.5	11.8	11.7	12.0	12.0	11.1	9.6	8.4	8.3	8.1	7.6	6.9	8.9
Winnemucca, Nev ...	9.3	9.8	9.8	9.0	8.5	8.1	8.3	8.5	7.7	7.5	8.0	8.3	7.8	8.7	9.2	10.2	10.8	10.8	10.7	11.1	11.5	12.1	10.4	9.4	9.4
Woods Hole, Mass.....	13.4	13.0	12.6	12.7	12.6	12.8	12.4	13.8	13.8	14.4	14.2	14.7	15.8	17.0	17.0	17.7	17.0	15.8	15.1	14.5	14.2	13.9	14.6	13.2	14.4
Yankton, S. Dak.....	5.7	4.7	4.8	4.2	4.7	4.1	4.5	5.2	5.5	7.3	8.6	9.2	9.7	10.1	9.9	10.0	9.5	9.2	8.8	7.8	6.5	5.9	5.6	5.5	7.0
West Indies.																									
Basseterre, St. Kitts.	10.9	11.2	11.1	11.6	11.1	11.0	11.2	11.8	12.2	12.9	12.8	12.7	12.3	12.5	11.9	11.6	11.1	10.5	10.9	10.8	11.1	11.0	11.3	11.3	11.5
Bridgetown, Bar.....	5.6	5.7	6.0	6.1	6.3	6.8	9.8	13.0	13.7	14.5	14.8	15.0	14.5	14.4	13.8	12.4	10 6	8.2	6.8	6.4	6.9	6.6	6.5	6.2	9.6
Cienfuegos, Cuba....	5.3	5.9	5.7	5.2	5.7	5.5	4.8	5.2	5.4	6.1	6.9	7.1	7.7	7.8	8.1	7.7	7.5	6.9	5.6	5.1	5.4	5.3	5.3	5.2	6.1
Havana, Cuba.....	4.9	4.8	3.9	4.3	4.3	4.2	4.2	5.4	7.5	7.9	9.2	10.5	13.1	14.4	14.8	14.0	13.2	12.1	11.5	9.5	8.3	7.7	6.0	5.3	8.4
Kingston, Jamaica...	4.4	4.4	4.5	4.4	4.7	5.1	4.5	3.8	3.9	5.6	8.6	13.1	16.0	16.5	15.7	13.6	10.9	7.0	4.8	3.5	3.6	3.8	3.9	4.3	7.1
Port of Spain, Trin...	2.3	1.9	2.1	2.3	2.1	2.1	2.3	4.3	5.9	7.2	7.9	8.4	7.9	8.3	7.8	7.5	6.4	4.7	3.3	2.8	2.6	2.2	2.1	1.9	4.4
Puerto Principe, Cuba	4.9	4.7	4.6	4.6	4.7	4.5	4.7	9.4	12.7	11.9	10.5	9.4	9.2	9.5	11.0	11.8	11.0	9.8	8.6	7.5	6.6	5.7	5.3	5.0	7.8
San Juan, Porto Rico.	5.4	4.6	4.5	4.2	4.6	4.7	5.2	7.4	9.0	10.1	11.1	11.5	11.9	12.2	11.9	11.5	10.4	9.6	8.6	8.6	8.2	7.3	7.1	6.6	8.2
Santiago de Cuba....	3.8	3.8	3.5	3.4	3.1	3.1	3.7	4.9	5.4	6.3	6.4	6.9	8.4	8.5	8.5	7.4	6.0	4.5	3.2	3.1	3.1	4.0	3.8	4.1	5.0
Santo Domingo, S. D.	3.4	3.7	3.5	3.8	3.6	3.7	3.7	4.8	5.2	5.4	5.7	5.9	5.7	6.3	5.8	5.7	4.7	4.4	3.9	4.5	4.3	4.2	3.7	3.9	4.6
Willemstad, Curaçao.	10.6	9.9	9.5	9.1	9.2	9.1	10.7	13.3	14.6	15.2	15.6	15.8	16.1	15.8	16.0	15.5	15.4	14.0	13.4	12.2	11.8	11.5	11.1	10.6	12.8

TABLE VI.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of July, 1899.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	10	27	5	31	s. 57 w.	31
Portland, Me	11	28	12	26	s. 39 w.	22
Northfield, Vt	26	28	7	11	s. 63 w.	4
Boston, Mass	11	20	10	34	s. 69 w.	26
Nantucket, Mass	7	30	7	37	s. 53 w.	38
Woods Hole, Mass	6	27	8	36	s. 53 w.	35
Block Island, R. I	8	27	1	37	s. 62 w.	41
New Haven, Conn	14	23	7	33	s. 71 w.	28
Middle Atlantic States.						
Albany, N. Y	12	32	7	18	s. 29 w.	23
Binghamton, N. Y.†	13	5	2	16	n. 60 w.	16
New York, N. Y	16	27	10	22	s. 47 w.	16
Harrisburg, Pa.†	5	8	7	16	s. 72 w.	10
Philadelphia, Pa	10	26	8	31	s. 55 w.	28
Atlantic City, N. J	9	30	9	33	s. 49 w.	32
Cape May, N. J	5	38	6	20	s. 23 w.	36
Baltimore, Md	5	29	14	28	s. 30 w.	28
Washington, D. C	13	32	12	18	s. 18 w.	20
Lynchburg, Va	12	32	19	18	s. 3 e.	20
Norfolk, Va	8	36	20	13	s. 14 e.	29
Richmond, Va	12	33	15	14	s. 3 e.	21
South Atlantic States.						
Charlotte, N. C	15	25	20	14	s. 31 e.	12
Hatteras, N. C	12	37	10	15	s. 11 w.	26
Raleigh, N. C	14	30	15	16	s. 3 w.	16
Wilmington, N. C	10	29	17	23	s. 18 w.	20
Charleston, S. C	10	35	14	15	s. 2 w.	25
Augusta, Ga	12	30	19	15	s. 13 e.	18
Macon, Ga †	10	10	9	8	e.	1
Savannah, Ga	12	31	16	18	s. 6 w.	18
Jacksonville, Fla	12	36	18	15	s. 7 e.	24
Florida Peninsula.						
Jupiter, Fla	2	40	24	12	s. 18 e.	40
Key West, Fla	6	22	40	6	s. 65 e.	38
Tampa, Fla	13	19	27	14	s. 69 e.	14
Eastern Gulf States.						
Atlanta, Ga	9	25	17	26	s. 29 w.	18
Pensacola, Fla.†	14	7	9	13	n. 30 w.	8
Mobile, Ala	18	22	7	25	s. 77 w.	18
Montgomery, Ala	13	33	18	12	s. 17 e.	21
Meridian, Miss.†	6	13	6	15	s. 52 w.	11
Vicksburg, Miss	11	25	17	11	s. 23 e.	15
New Orleans, La	12	33	10	27	s. 39 w.	27
Western Gulf States.						
Shreveport, La	13	31	12	20	s. 24 w.	20
Fort Smith, Ark	14	11	32	14	n. 81 e.	18
Little Rock, Ark	24	21	19	16	n. 45 e.	4
Corpus Christi, Tex	3	38	34	5	s. 40 e.	46
Fort Worth, Tex†	4	19	3	9	s. 22 w.	16
Galveston, Tex	7	40	14	16	s. 3 w.	33
Palestine, Tex	11	34	24	14	s. 23 e.	25
San Antonio, Tex	10	33	35	2	s. 55 e.	40
Ohio Valley and Tennessee.						
Chattanooga, Tenn	25	20	15	19	n. 39 w.	6
Knoxville, Tenn	21	17	21	19	n. 27 e.	4
Memphis, Tenn	28	21	9	19	n. 55 w.	12
Nashville, Tenn	22	14	10	26	n. 63 w.	18
Lexington, Ky.†	4	14	9	11	s. 8 w.	14
Louisville, Ky	21	23	10	18	s. 76 e.	8
Evansville, Ind.†	9	12	9	6	s. 45 e.	4
Indianapolis, Ind	24	21	10	22	n. 76 w.	12
Cincinnati, Ohio	13	26	21	19	s. 9 e.	13
Columbus, Ohio	13	25	15	23	s. 34 w.	14
Pittsburg, Pa	26	15	7	28	n. 62 w.	24
Parkersburg, W. Va	10	28	16	21	s. 16 w.	19
Elkins, W. Va	22	22	9	17	w.	8
Lower Lake Region.						
Buffalo, N. Y	15	21	9	33	s. 76 w.	25
Oswego, N. Y	13	33	11	22	s. 29 w.	23
Rochester, N. Y	16	21	5	31	s. 80 w.	29
Erie, Pa	10	15	6	40	s. 82 w.	34
Cleveland, Ohio	15	21	19	18	s. 9 e.	6
Sandusky, Ohio	13	23	20	23	s. 52 w.	16
Toledo, Ohio	12	19	12	23	s. 58 w.	13
Detroit, Mich	25	18	14	18	n. 27 w.	9
Upper Lake Region.						
Alpena, Mich	22	21	15	18	n. 72 w.	3
Escanaba, Mich	21	27	14	16	s. 18 w.	6
Grand Haven, Mich	18	14	14	28	n. 74 w.	15
Marquette, Mich	25	15	16	24	n. 39 w.	13
Port Huron, Mich	31	16	8	14	n. 22 w.	16
Sault Ste. Marie, Mich	16	13	21	28	n. 67 w.	8
Chicago, Ill	17	21	26	20	s. 51 e.	6
Milwaukee, Wis	23	14	24	14	n. 48 e.	14
Green Bay, Wis	19	23	19	16	s. 37 e.	5
Duluth, Minn	26	12	20	24	n. 16 w.	15
North Dakota.						
Moorhead, Minn	23	20	19	19	n.	3
Bismarck, N. Dak	26	8	27	13	n. 38 e.	23
Williston, N. Dak	28	18	12	13	n. 6 w.	10
Upper Mississippi Valley.						
St. Paul, Minn	16	25	11	23	s. 53 w.	15
La Crosse, Wis. †	8	14	5	10	s. 40 w.	8
Davenport, Iowa	14	20	15	27	s. 63 w.	13
Des Moines, Iowa	22	20	13	23	n. 81 w.	13
Dubuque, Iowa	20	21	10	29	s. 87 w.	19
Keokuk, Iowa	16	27	9	26	s. 57 w.	20
Cairo, Ill	22	24	13	14	s. 27 w.	2
Springfield, Ill	21	14	13	24	n. 58 w.	13
Hannibal Mo.†	8	12	8	9	s. 14 w.	4
St. Louis, Mo	20	21	14	20	s. 80 w.	6
Missouri Valley.						
Columbia, Mo.*	8	12	8	12	s. 45 w.	6
Kansas City, Mo	21	25	26	8	s. 77 e.	18
Springfield, Mo	20	22	21	10	s. 80 e.	11
Lincoln, Nebr	23	29	21	5	s. 69 e.	17
Omaha, Nebr	27	19	24	8	n. 63 e.	18
Sioux City, Iowa†	10	16	8	6	s. 18 e.	6
Pierre, S. Dak	15	26	27	11	s. 56 e.	19
Huron, S. Dak	17	25	21	15	s. 37 e.	10
Yankton, S. Dak †	8	10	5	11	s. 72 w.	6
Northern Slope.						
Havre, Mont	18	12	15	32	n. 71 w.	18
Miles City, Mont	21	14	14	13	n. 8 e.	7
Helena, Mont	14	25	8	35	s. 68 w.	29
Kalispell, Mont	27	17	13	23	w. 45 w.	14
Rapid City, S. Dak	17	14	11	30	n. 81 w.	19
Cheyenne, Wyo	19	21	11	21	s. 79 w.	10
Lander, Wyo	17	22	12	30	s. 74 w.	19
North Platte, Nebr	9	31	22	9	s. 30 e.	26
Middle Slope.						
Denver, Colo	22	23	11	17	s. 80 w.	6
Pueblo, Colo	20	15	21	18	n. 45 e.	4
Concordia, Kans	12	29	15	11	s. 13 e.	18
Dodge, Kans	13	29	30	5	s. 57 e.	30
Wichita, Kans	12	32	28	1	s. 53 e.	34
Oklahoma, Okla	10	33	23	4	s. 40 e.	30
Southern Slope.						
Abilene, Tex	8	38	34	2	s. 47 e.	44
Amarillo, Tex	6	43	13	9	s. 6 e.	37
Southern Plateau.						
El Paso, Tex	20	13	37	9	n. 70 e.	30
Santa Fe, N. Mex	11	26	31	12	s. 52 e.	24
Flagstaff, Ariz	22	15	7	33	n. 63 w.	29
Phenix, Ariz	13	10	24	26	n. 34 w.	4
Yuma, Ariz	7	23	15	28	s. 39 w.	21
Independence, Cal	17	21	16	24	s. 63 w.	9
Middle Plateau.						
Carson City, Nev	10	18	1	44	s. 80 w.	44
Winnemucca, Nev	18	18	14	29	w.	15
Cedar City, Utah	7	35	26	14	s. 23 e.	30
Salt Lake City, Utah	24	20	24	10	n. 74 e.	15
Grand Junction, Colo	16	20	28	15	s. 73 e.	14
Northern Plateau.						
Baker City, Oreg	19	35	7	12	s. 17 w.	17
Boise, Idaho	9	19	18	33	s. 56 w.	18
Pocatello, Idaho	7	34	15	19	s. 8 w.	27
Spokane, Wash	19	21	21	17	s. 63 e.	4
Walla Walla, Wash	12	29	11	17	s. 19 w.	18
North Pacific Coast Region.						
Fort Canby, Wash	36	7	6	24	n. 32 w.	34
Neah, Wash	5	4	9	46	n. 88 w.	37
Port Crescent, Wash.*	1	0	6	35	n. 87 w.	19
Seattle, Wash	23	16	11	24	n. 62 w.	15
Portland, Oreg	29	17	11	24	n. 47 w.	18
Roseburg, Oreg	48	2	19	10	n. 11 e.	46
Middle Pacific Coast Region.						
Eureka, Cal	29	14	3	37	n. 60 w.	37
Mount Tamalpais, Cal	26	3	1	45	n. 62 w.	50
Red Bluff, Cal	19	29	21	11	s. 63 e.	22
Sacramento, Cal	3	45	11	23	s. 16 w.	44
San Francisco, Cal	0	25	0	52	s. 64 w.	58
South Pacific Coast Region.						
Fresno, Cal	34	4	0	44	n. 56 w.	53
Los Angeles, Cal	4	16	3	45	s. 74 w.	44
San Diego, Cal	29	9	3	36	n. 59 w.	39
San Luis Obispo, Cal	28	15	2	21	n. 56 w.	23
West Indies.						
Basseterre, St. Kitts Island	11	1	57	0	n. 80 e.	57
Bridgetown, Barbados	9	5	56	0	n. 86 e.	56
Cienfuegos, Cuba	40	5	36	5	n. 41 e.	47
Havana, Cuba	13	10	49	1	n. 86 e.	48
Kingston, Jamaica	45	4	14	9	n. 7 e.	41
Port of Spain, Trinidad	10	7	46	6	n. 86 e.	40
San Juan, Porto Rico	0	14	54	1	s. 75 e.	55
Santiago de Cuba, Cuba	29	18	26	6	n. 61 e.	23
Willemstad, Curaçao	2	4	59	0	s. 88 e.	59

* From observations at 8 p. m. only.

† From observations at 8 a. m. only.

TABLE VII.—*Thunderstorms and auroras, July, 1899.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	53	T.	1	....	....	....	6	3	5	5	3	4	....	....	....	....	2	5	4	8	6	9	9	9	9	6	8	9	6	4	1	3	....	125	23	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Arizona	53	T.	2	3	2	3	2	2	5	4	11	9	8	7	4	8	6	6	12	9	11	5	6	5	10	8	7	6	9	8	7	6	10	201	31	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Arkansas	57	T.	....	2	3	8	3	6	13	1	....	....	....	....	....	3	3	10	10	3	2	5	7	12	10	7	1	1	4	6	7	3	6	136	25	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
California	189	T.	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	....	....	....	2	1	....	....	....	1	....	....	....	....	....	....	....	7	5	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Colorado	73	T.	11	16	17	12	3	11	11	6	4	6	11	15	16	19	19	12	7	2	3	1	8	11	12	....	4	12	15	10	10	9	2	295	30	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Connecticut	22	T.	....	....	....	....	....	3	1	12	2	....	....	12	1	..	....	4	1	....	1	....	....	4	7	....	....	1	10	..	....	6	....	65	14	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Delaware	5	T.	....	....	....	....	1	2	1	3	....	....	....	....	2	....	....	1	....	....	....	....	....	....	....	....	....	1	1	....	....	....	....	12	8	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Dist. of Columbia	4	T.	....	..	....	1	1	1	....	1	....	....	.	1	1	....	1	1	1	....	....	....	....	....	1	....	....	1	1	1	1	....	....	14	14	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Florida	45	T.	7	5	3	7	6	7	8	7	7	8	3	7	8	3	3	4	2	5	7	6	10	8	4	5	2	3	....	....	2	6	1	154	29	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Georgia	54	T.	....	....	....	1	4	4	2	7	1	....	1	....	....	..	1	3	5	4	7	7	1	1	...	4	3	2	1	2	1	4	3	69	28	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Idaho	27	T.	....	....	3	1	1	....	..	1	1	....	1	7	3	4	2	5	1	1	2	3	1	1	1	1	2	8	2	3	6	5	4	70	26	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	1	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3	A.
Illinois	92	T.	....	2	17	22	9	1	10	....	....	1	3	8	4	10	16	15	....	....	....	....	....	2	....	15	....	3	3	11	15	1	16	184	21	T.
		A.	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	2	A.
Indiana	55	T.	....	..	1	4	9	..	10	1	....	....	2	....	12	2	14	9	2	....	....	....	2	....	....	16	10	1	5	3	12	....	....	115	18	T.
		A.	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	2	A.
Indian Territory	8	T.	....	2	2	2	1	....	2	3	....	....	....	....	....	....	....	2	2	1	....	....	1	1	....	2	....	....	..	....	....	....	....	2	2	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	28	13	A.
Iowa	126	T.	....	17	12	2	11	18	6	....	2	11	....	14	5	12	9	3	..	....	1	....	1	....	2	9	2	6	5	14	4	1	14	181	24	T.
		A.	....	....	1	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Kansas	74	T.	1	7	15	13	4	15	15	....	....	4	6	1	3	16	14	10	1	....	5	5	3	....	2	6	....	....	....	5	10	5	10	176	24	T.
		A.	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	A.
Kentucky	45	T.	....	....	....	1	5	....	8	1	....	....	....	....	1	..	6	17	4	....	....	....	1	1	....	7	10	1	....	10	13	6	....	92	16	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Louisiana	45	T.	7	9	6	8	5	6	6	7	6	1	4	1	1	4	6	6	10	10	6	6	4	2	4	3	8	6	4	4	....	1	....	151	29	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Maine	17	T.	....	....	....	5	3	8	1	....	2	1	2	8	3	....	....	....	1	1	....	....	12	1	....	....	1	1	2	....	....	6	....	58	17	T.
		A.	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	1	A.
Maryland	39	T.	....	....	....	6	14	19	....	15	....	....	1	14	16	....	11	16	6	1	1	1	4	2	7	....	5	8	9	10	3	....	....	164	21	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Massachusetts	54	T.	....	....	....	....	1	9	1	19	8	....	....	10	1	....	....	....	....	....	....	....	1	8	1	1	....	....	16	....	1	3	....	80	14	T.
		A.	....	....	3	....	....	....	....	....	1	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	3	A.
Michigan	107	T.	1	3	9	2	3	4	30	2	....	4	4	1	3	2	5	3	2	1	13	5	2	3	1	14	8	8	....	6	1	..	....	130	27	T.
		A.	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	A.
Minnesota	64	T.	....	2	2	1	8	7	..	....	6	12	....	18	6	5	8	5	....	3	....	....	....	....	10	7	8	3	....	10	....	..	6	127	19	T.
		A.	....	..	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	1	A.
Mississippi	42	T.	6	2	....	7	9	6	8	3	3	3	2	....	2	4	5	6	9	8	8	7	6	5	7	9	7	3	4	1	1	....	2	143	28	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Missouri	89	T.	....	5	10	11	2	16	14	....	....	2	3	....	....	8	16	15	2	..	....	2	4	5	6	3	....	....	....	9	18	2	17	165	21	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Montana	87	T.	....	2	7	9	2	....	5	2	4	2	2	4	6	8	....	....	....	....	1	10	7	2	1	1	....	2	4	1	6	7	7	102	24	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2	2	A.
Nebraska	145	T.	1	18	4	7	16	7	4	....	5	5	11	10	4	1	9	2	....	....	....	....	2	5	2	....	2	10	12	4	3	12	156	24	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Nevada	45	T.	....	1	....	....	....	....	....	....	....	1	1	1	2	1	1	....	....	1	1	1	....	....	....	4	5	....	....	3	1	....	....	24	14	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
New Hampshire	20	T.	....	....	...	4	6	7	..	8	1	....	4	9	....	..	....	....	3	....	....	....	10	1	....	....	....	....	3	....	....	2	....	58	12	T.
		A.	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	2	A.
New Jersey	50	T.	....	....	....	....	16	16	1	20	....	....	2	18	1	....	2	11	5	...	....	....	12	17	11	....	2	1	24	5	11	2	...	177	19	T.
		A.	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	2	A.
New Mexico	38	T.	1	3	5	..	1	4	5	4	1	3	5	4	5	6	5	5	3	2	3	1	2	3	4	5	1	3	3	2	4	3	2	98	30	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
New York	103	T.	....	....	3	22	16	11	7	37	5	3	17	32	2	1	3	7	14	4	1	6	14	4	4	1	6	2	7	...	10	5	...	244	27	T.
		A.	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2	2	A.
North Carolina	56	T.	...	...	1	6	5	10	7	10	1	....	....	....	....	....	5	10	17	1	2	5	....	3	4	4	5	5	2	2	1	14	2	122	23	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
North Dakota	40	T.	1	4	2	1	5	1	..	1	3	4	2	5	...	1	3	....	....	....	1	....	5	8	5	....	1	....	1	1	....	2	7	64	22	T.
		A.	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	A.
Ohio	134	T.	....	....	5	....	18	5	27	14	....	....	4	2	26	7	13	24	7	...	19	2	3	4	1	5	25	1	11	12	21	1	...	256	24	T.
		A.	....	1	....	....	....	....	1	1	....	....	1	....	....	....	....	....	....	....	....	....	1	1	....	....	1	....	....	....	1	....	....	8	8	A.
Oklahoma	22	T.	....	1	3	....	....	1	4	2	....	....	....	1	..	1	4	3	3	1	4	4	3	2	2	1	....	....	....	..	1	..	....	41	18	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Oregon	71	T.	....	....	....	....	....	....	....	....	....	1	....	4	4	3	2	1	1	....	....	1	....	....	....	....	....	2	1	12	5	2	..	39	13	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Pennsylvania	100	T.	....	...	1	3	28	18	6	25	3	....	6	16	2	1	9	20	7	....	1	10	3	9	2	1	8	3	18	2	15	4	....	221	26	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Rhode Island	8	T.	....	....	....	....	....	2	....	5	2	....	....	4	....	....	....	....	....	....	....	....	1	3	2	..	....	..	1	....	....	....	....	....	20	8	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
South Carolina	44	T.	....	....	2	....	8	7	6	13	....	....	1	....	....	....	....	1	9	6	3	....	....	2	3	3	6	4	8	3	1	9	7	102	20	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
South Dakota	52	T.	....	1	3	7	11	1	1	1	2	1	2	8	1	4	1	....	....	1	...	1	....	2	5	....	3	1	1	7	1	4	8	78	25	T.
		A.	....	1	1	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	5	5	A.
Tennessee	61	T.	....	....	..	1	6	3	2	3	....	....	....	....	....	....	2	13	12	....	....	1	5	2	7	11	12	11	2	8	8	3	....	112	19	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Texas	83	T.	3	6	1	3	....	1	..	1	2	3	2	4	2	1	2	3	2	4	5	....	....	....	3	2	3	3	....	2	1	....	....	59	23	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Utah	34	T.	9	7	3	2	....	....	....	2	3	7	12	11	4	10	6	6	5	4	1	4	5	2	1	1	7	6	2	6	3	....	....	129	26	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Vermont	14	T.	....	....	2	6	6	8	1	4	6	1	4	6	....	....	....	....	6	....	....	1	10	....	....	....	1	....	1	....	1	1	....	65	17	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	A.
Virginia	47	T.	....	....	....	3	7	12	2	11	....	....	....	1	3	....	8	10	12	....	....	1	1	2	5	....	....	2	....	7	3	9	....	99	18	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Washington	55	T.	1	1	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1	3	9	3	....	21	8	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
West Virginia	38	T.	1	....	....	1	7	8	4	6	1	....	....	1	10	1	8	11	7	....	....	1	2	2	1	1	8	4	1	7	5	5	....	103	24	T.
		A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	A.
Wisconsin	60	T.	....	....	2	1	3	6	1	..	2	7	....	2	2	1	7	9	1	7	4	....	....	1	1	10	2	3	....	2	1	1	2	78	24	T.
		A.	....	....	1	....	....	1	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3	A.
Wyoming	18	T.	1	3	3	2	....	2	2	2	2	....	2	3	3	4	3	....	1	....	....	2	2	2	....	....	....	1	3	2	4	1	1	51	23	T.
		A.	....	..	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	....	....	3	3	A.
Sums	2,804	T.	54	122	151	195	272	278	232	268	99	104	128	270	169	153	241	294	197	88	121	114	169	154	161	176	181	135	201	216	224	150	139	5,476	...	T.
		A.	0	2	11	1	1	1	5	1	1	4	1	2	2	0	2	2	0	0	1	1	1	1	0	0	1	0	0	0	3	2	4	50	....	A.

TABLE VIII.—*Average hourly sunshine (in percentages), July, 1899.*

Stations.	Instrument.	Percentages for each hour of local mean time ending with the respective hour.																Hours of sunshine.			
		A. M.								P. M.								Total.			
		5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	Actual.	Possible.	Percent of possible.	Personal estimate.
																		Hours.	*Hours.*		
Albany, N. Y	T.	40	39	45	64	72	77	85	88	93	90	87	81	74	61	46	35	321.9	465.2	69	42
Atlanta, Ga	T.	50	39	40	53	63	73	78	84	80	77	74	66	63	44	32	38	270.5	439.7	62	46
Atlantic City, N. J	P.	57	60	58	59	64	61	67	70	74	73	72	70	68	62	47	42	289.8	453.0	64	53
Baltimore, Md	T.	40	40	54	73	78	90	91	88	89	88	87	77	66	57	33	26	319.5	453.0	71	54
Binghamton, N. Y	T.	32	26	27	43	56	65	76	78	81	76	66	65	47	37	39	29	251.6	461.8	54	42
Bismarck, N. Dak	P.	60	68	76	79	78	77	77	77	64	71	76	75	79	71	75	71	353.9	479.6	74	65
Boise, Idaho	P.	67	74	86	91	94	90	95	95	96	94	88	88	87	83	77	77	409.0	468.4	87	80
Boston, Mass	T.	53	57	63	64	73	78	75	73	76	74	78	75	72	65	54	43	315.7	461.8	68	67
Buffalo, N. Y	T.	45	49	67	69	79	90	89	86	93	95	91	82	74	68	47	38	347.6	465.2	75	46
Charleston, S. C	T.	57	40	50	44	48	61	57	71	66	57	75	71	59	34	19	27	233.7	437.2	53	48
Chattanooga, Tenn	T.	76	58	55	54	59	62	70	66	71	62	62	68	61	56	47	57	268.8	442.0	61	48
Cheyenne, Wyo	P.	42	69	78	85	88	85	83	79	73	65	58	46	40	45	30	9	291.6	458.6	64	40
Chicago, Ill	T.	27	30	51	68	80	79	83	81	82	78	74	75	60	55	45	48	302.5	461.8	66	55
Cincinnati, Ohio	T.	63	55	57	64	78	81	91	90	90	92	82	83	82	75	60	58	346.1	453.0	76	58
Cleveland, Ohio	T.	53	52	55	64	66	69	73	79	78	77	72	58	52	47	32	34	282.6	461.8	61	56
Columbia, Mo	T.	54	57	72	89	94	96	100	100	100	95	93	94	91	86	70	48	393 4	453.0	87	44
Columbus, Ohio	T.	58	55	55	60	69	75	80	78	75	66	62	62	55	40	45	47	283.3	455.2	62	64
Denver, Colo	P.	51	57	63	73	83	87	88	78	68	62	50	49	62	52	41	36	291.5	455.2	64	55
Des Moines, Iowa	T.	50	45	41	59	56	74	78	81	81	79	75	74	61	61	56	51	300.3	461.8	65	54
Detroit, Mich	T.	54	55	64	71	83	81	86	88	89	89	89	85	87	79	56	31	353.0	461.8	76	52
Dodge, Kans	P.	36	49	58	59	62	63	65	66	67	69	65	64	62	59	51	47	273.4	450.1	61	50
Dubuque, Iowa	T.	62	64	65	70	72	81	80	82	82	90	85	78	79	68	69	69	348.4	461.8	75	67
Eastport, Me	P.	25	38	48	58	54	54	59	54	56	64	67	64	57	53	40	32	246.7	471.7	52	38
Elkins, W. Va	T.	6	3	21	58	68	81	86	86	88	82	74	74	60	38	7	8	257.9	453.0	57	43
Erie, Pa	T.	54	52	55	61	73	85	82	86	81	81	74	71	70	58	34	29	317.3	461.8	69	54
Escanaba, Mich	T.	33	39	41	42	58	54	57	52	73	70	56	49	45	29	14	6	217.4	475.7	46	45
Eureka, Cal	P.	12	13	13	17	24	27	30	45	48	49	52	49	48	50	48	49	167.8	458.6	37	37
Fresno, Cal	T.	81	91	97	100	100	100	100	100	100	100	100	100	99	97	91	88	438.0	447.4	98	96
Galveston, Tex	P.	.....	22	73	83	85	84	81	76	84	84	78	69	72	68	33	25	306.8	427.4	72	53
Grand Junction, Colo	P.	93	88	76	75	85	84	86	85	75	75	76	69	58	58	61	71	341.4	453.0	75	55
Harrisburg, Pa	T.	70	61	55	53	59	72	76	77	82	81	80	64	53	46	43	44	291.1	455.2	64	46
Helena, Mont	P.	56	69	81	86	85	87	88	82	85	79	73	71	69	67	66	46	360.1	479.6	75	58
Huron, S. Dak	T.	65	68	67	63	74	82	85	91	84	76	73	68	58	47	48	49	324.2	468.4	69	57
Indianapolis, Ind	T.	44	42	42	49	64	71	72	78	75	75	71	70	60	45	39	39	272.5	455.2	60	50
Jacksonville, Fla	T.	.....	26	34	59	71	76	81	81	79	81	67	47	41	20	3	0	236.0	429.6	55	38
Kalispell, Mont	T.	66	71	82	91	93	90	90	91	89	88	87	87	91	88	82	83	415.6	483.2	86	66
Kansas City, Mo	P.	57	55	58	61	61	63	60	59	56	55	62	67	66	58	50	53	268.4	453.0	59	49
Key West, Fla	T.	.....	0	8	46	70	70	77	73	72	67	71	68	57	30	20	.....	225.5	419.1	54	45
Knoxville, Tenn	T.	48	36	36	49	60	73	86	84	83	80	79	75	68	57	49	51	289.1	444.3	65	64
Lexington, Ky	T.	25	42	64	75	85	94	99	97	100	99	90	81	76	62	40	35	348.8	450.1	77	49
Little Rock, Ark	T.	52	48	49	62	70	73	76	68	65	68	73	68	63	55	55	55	281.2	442.0	64	54
Los Angeles, Cal	P.	50	33	38	50	76	90	98	100	100	100	100	99	99	96	95	93	370.0	439.7	84	78
Louisville, Ky	T.	76	68	65	65	73	84	86	90	88	87	71	66	58	46	41	42	315.1	450.1	70	47
Macon, Ga	T.	28	25	53	64	89	95	95	95	96	90	86	82	70	45	25	27	314.2	437.2	72	52
Meridian, Miss	T.	0	35	36	42	61	72	78	65	71	62	53	49	36	28	32	37	223.6	434.5	51	44
Minneapolis, Minn	T.	30	35	38	61	63	72	75	81	77	81	79	82	80	62	34	31	297.0	471.7	63	.....
Mount Tamalpais, Cal	P.	95	94	97	98	100	100	100	100	100	100	99	100	99	100	100	96	445.4	450.1	99	88
Nashville, Tenn	T.	23	23	26	43	58	67	69	67	68	69	67	64	57	55	29	28	239.6	444.3	54	52
New Orleans, La	T.	.....	35	77	83	84	85	85	89	92	84	82	79	72	63	50	55	327.6	429.6	76	63
New York, N. Y	T.	40	29	45	62	67	71	70	80	82	86	90	73	65	51	39	35	291.4	458.6	64	48
Northfield, Vt	P.	36	36	46	53	62	64	59	60	47	49	55	53	52	45	45	44	239.0	468.4	51	39
Oklahoma, Okla	T.	43	49	50	78	89	88	86	84	90	92	91	91	89	83	64	52	355.6	442.0	80	64
Omaha, Nebr	P.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
Parkersburg, W. Va	T.	34	35	35	38	50	60	67	72	68	59	57	50	42	19	16	16	212.0	453.0	47	49
Phenix, Ariz	P.	43	55	63	75	75	80	78	91	89	94	95	93	80	65	56	59	339.5	437.2	78	64
Philadelphia, Pa	T.	51	45	48	55	69	72	85	87	90	85	79	71	69	49	40	38	302.2	455.2	66	44
Pittsburg, Pa	T.	64	61	62	67	77	85	88	92	84	85	87	82	76	64	55	55	344.6	458.6	75	64
Pocatello, Idaho	T.	58	50	64	83	88	90	93	94	91	82	79	74	63	53	55	52	344.4	465.2	74	65
Portland, Me	T.	27	39	66	75	85	91	92	95	92	94	94	88	80	63	53	32	354.1	468.4	76	46
Portland, Oreg	T.	41	43	51	55	60	70	74	77	84	88	90	86	85	80	63	60	334.0	475.7	70	71
Raleigh, N. C	T.	52	37	50	66	71	85	84	86	90	82	79	69	59	33	26	29	287.6	444.3	65	46
Rochester, N. Y	T.	59	61	71	83	91	92	94	95	92	91	94	93	80	63	49	32	369.7	465.2	79	69
St. Louis, Mo	T.	54	48	61	74	85	90	85	87	84	89	92	82	80	66	49	44	341.3	453.0	75	48
St. Paul, Minn	P.	55	55	65	70	74	76	78	74	69	75	76	78	81	73	61	66	332.7	471.7	71	57
Salt Lake City, Utah	P.	52	67	77	72	81	88	83	89	81	89	82	83	74	72	53	47	350.2	458.6	76	69
San Diego, Cal	P.	0	7	16	37	68	77	90	90	90	97	97	95	92	87	87	86	323.4	437.2	74	72
San Francisco, Cal	T.	15	17	25	31	48	65	81	93	96	96	99	97	85	66	38	30	294.1	450.1	65	64
Santa Fe, N. Mex	P.	65	69	79	78	82	82	84	80	72	72	70	73	59	46	29	25	306.2	444.3	69	51
Savannah, Ga	T.	33	54	57	71	85	88	95	93	82	83	81	69	57	43	36	37	307.6	434.5	71	49
Seattle, Wash	T.	36	35	38	43	49	60	69	72	77	75	72	71	70	63	56	56	286.9	483.2	59	61
Spokane, Wash	T.	46	46	64	80	89	93	93	91	92	88	83	85	80	77	66	65	376.8	483.2	78	66
Tacoma, Wash	T.	46	44	43	45	58	68	78	80	81	83	82	81	78	76	62	60	322.3	479.6	67	64
Tampa, Fla	T.	.....	56	55	57	68	67	65	60	62	59	56	53	47	41	36	.....	237.7	424.9	56	28
Topeka, Kans.*	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48
Vicksburg, Miss	T.	33	39	39	62	86	93	89	90	93	87	77	70	62	57	36	40	303.7	434.5	70	64
Washington, D. C	P.	60	56	60	68	71	75	71	73	73	69	71	67	60	50	44	42	291.0	453.0	64	56
Wilmington, N. C	T.	25	16	19	39	61	61	67	75	71	68	64	58	54	29	13	14	216.3	439.7	49	40
Yankton, S. Dak	T.	31	37	61	76	82	85	88	93	89	92	90	86	73	65	45	32	338.7	465.2	73	56
Basseterre, St. Kitts	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38
Bridgetown, Barbados	T.	.....	16	45	65	75	82	85	84	83	85	82	70	49	22	6	.....	259.4	397.5	65	30
Cienfuegos, Cuba	T.	.....	72	71	75	87	89	90	91	88	83	68	44	26	19	19	.....	275.5	413.5	67	65
Havana, Cuba	T.	.....	32	32	41	66	61	61	79	89	76	67	49	39	33	33	.....	228.5	415.1	55	58
Kingston, Jamaica, W. I	T.	.....	72	72	93	95	95	93	92	85	80	79	66	46	36	30	.....	304.8	406.2	75	39
Port of Spain, Trinidad, W. I	T.	.....	22	22	56	70	71	81	85	81	73	68	59	52	42	42	.....	242.5	393.7	62	43
Puerto Principe, Cuba	T.	.....	76	77	71	74	95	91	90	87	72	59	38	33	26	23	.....	270.0	411.7	66	43
Roseau, Dominica, W. I	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Juan, Porto Rico	T.	.....	8	29	72	81	88	95	95	90	85	88	73	65	37	16	.....	282.9	406.2	70	52
Santiago de Cuba, Cuba	T.	.....	79	80	78	91	85	65	65	80	79	74	48	27	12	2	.....	256.1	409.9	62	46
Santo Domingo, Santo Domingo	T.	.....	73	74	69	64	62	64	59	61	55	44	27	18	14	16	.....	202.6	406.2	50	50
Willemstad, Curaçao	T.	.....	17	23	55	78	83	87	90	94	95	97	91	79	49	48	.....	294.5	395.7	74	50

*Self-register out of order.

TABLE IX.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during July, 1899, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total am't of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time as indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	29			0.47								0.47									
Atlanta, Ga.	21	8.50 a.m.	2.30 p.m.	3.05	11.15 a.m.	12.45 p.m.	0.74	0.07	0.15	0.31	0.46	0.62	0.85	0.99	1.16	1.33	1.39	1.80	2.07	2.20	
Atlantic City, N. J.	25-26	7.10 p.m.	7.50 a.m.	1.72	4.45 a.m.	5.30 a.m.	0.25	0.04	0.08	0.18	0.34	0.50	0.65	0.75	0.82	0.90					
Baltimore, Md.	25-26			0.53														0.38			
Binghamton, N. Y.	17			0.31														0.30			
Bismarck, N. Dak.	2			0.22											0.22						
Boise, Idaho	31			0.01														0.01			
Boston, Mass.	26			0.99														0.40			
Buffalo, N. Y	5-6			0.95														0.47			
Cairo, Ill.	22	3.00 p.m.	6.30 p.m.	0.97	3.05 p.m.	3.35 p.m.	0.02	0.19	0.37	0.57	0.68	0.80	0.89	0.90	0.92						
Charleston, S. C.	18	1.20 a.m.	2.25 a.m.	0.64	1.36 a.m.	2.06 a.m.	T.	0.10	0.23	0.30	0.39	0.50	0.64								
Chicago*																					
Cincinnati, Ohio	7			0.67														0.55			
Cleveland, Ohio	15	9.50 a.m.	9.32 p.m.	1.85	7.45 p.m.	9.15 p.m.	0.59	0.12	0.17	0.21	0.25	0.29	0.33	0.41	0.44	0.50	0.62	0.70	1.11	1.26	
Columbia, Mo.	31	2.05 p.m.	3.02 p.m.	1.02	2.12 p.m.	2.32 p.m.	T.	0.21	0.54	0.83	0.93	1.00									
Columbus, Ohio	13	3.55 p.m.	10.15 p.m.	1.00	4.00 p.m.	4.15 p.m.	0.02	0.33	0.59	0.68	0.69										
Denver, Colo.	15-16			0.45											0.45						
Des Moines, Iowa	6			0.87														*			
Detroit, Mich.	21	2.10 p.m.	4.05 p.m.	1.19	2.30 p.m.	3.20 p.m.	0.03	0.06	0.19	0.39	0.53	0.67	0.73	0.77	0.92	1.04	1.07				
Dodge, Kans.	14	1.40 p.m.	3.50 p.m.	0.80	2.25 p.m.	2.55 p.m.	0.05	0.10	0.22	0.36	0.54	0.64	0.72								
	23	2.24 p.m.	11.45 p.m.	1.99	2.30 p.m.	3.10 p.m.	0.03	0.10	0.23	0.37	0.62	1.02	1.19	1.33	1.38	1.40					
Duluth, Minn.	6			0.48														*			
Eastport, Me.	21			0.80														0.48			
Elkins, W. Va.	28	2.08 p.m.	7.00 p.m.	1.47	2.45 p.m.	3.45 p.m.	0.14	0.12	0.14	0.21	0.34	0.39	0.41	0.44	0.63	0.73	0.78	1.14			
Erie, Pa.	16			0.37						0.37											
Escanaba, Mich.	16			0.52														0.51			
Fort Worth, Tex.	2			0.76														*			
Fresno, Cal.†																					
Galveston, Tex.	25-26	10.45 p.m.	4.15 p.m.	1.97	1.27 p.m.	2.15 p.m.	1.05	0.09	0.20	0.26	0.32	0.43	0.50	0.59	0.72	0.81	0.84	0.86			
Grand Junction, Colo.	11			0.08														0.08			
Hannibal, Mo.	4	12 10 p.m.	5.30 p.m.	1.18	3.50 p.m.	4.15 p.m.	0.12	0.22	0.48	0.73	0.89	0.97	1.00	1.01							
Harrisburg, Pa.	8			0.77														0.66			
Hatteras, N. C.	23	4.15 a.m.	10.30 a.m.	3.37	8.40 a.m.	9.40 a.m.	1.11	0.17	0.65	0.77	1.00	1.19	1.37	1.47	1.69	1.89	2.01	2.13			
Huron, S. Dak.	5	7.50 a.m.	10.16 a.m.	0.65	8.40 a.m.	9.05 a.m.	0.08	0.16	0.26	0.43	0.50	0.54									
Indianapolis, Ind.	25	7.07 a.m	11.40 a.m.	1.22	8.30 a.m.	9.20 a.m.	0.09	0.06	0.15	0.23	0.28	0.47	0.62	0.72	0.79	0.91	0.94				
Jacksonville, Fla.	11	2.20 p.m.	3.15 p.m.	1.14	2.28 p.m.	2.53 p.m.	0.02	0.21	0.48	0.75	0.96	1.08	1 11								
	19	5.30 p.m.	10.30 p.m.	1.39	6.25 p.m.	7.00 p.m	0.03	0.03	0.26	0.48	0.72	0.83	0.90	0.94							
Jupiter, Fla.	24	4.00 p.m.	6.20 p.m.	0.60	4.11 p.m.	4.30 p.m.	0.05	0.05	0.16	0.30	0.39	0.40									
Kansas City, Mo.	6	9.54 a.m.	11.45 a.m.	0.76	9.56 a.m.	10.20 a.m.	0.01	0.19	0.38	0.53	0.64	0.70	0.73								
Key West, Fla.	1			0.75										0.75							
Knoxville, Tenn.	22			1.34														0.56			
Lexington, Ky.	16			0.20												0.20					
Lincoln, Nebr.	2			0.84														0.49			
Little Rock, Ark.	18	1.00 p.m	2.40 p.m.	0.85	1.18 p.m.	1.38 p.m.	T.	0.25	0.53	0.71	0.82	0.84									
	20	3.20 p.m.	5.30 p.m.	1.23	3.40 p.m.	4.25 p.m.	0.03	0.10	0.32	0.55	0.72	0.73	0.88	1.02	1.11	1.20					
	22	D. N.	12.40 p.m.	2.81	8.02 a.m.	8.57 a.m.	0.32	0.13	0.16	0.25	0.45	0.53	0.71	0.80	0.87	0.92	0.98	1.16			
					10.03 a.m.	10.55 a.m.	1.50	0.14	0.31	0.39	0.56	0.70	0.85	0.95	1.02	1.09	1.13	1.19			
Los Angeles, Cal.†																					
Louisville, Ky.	16			0.62														0.45			
Macon, Ga.	8	5.03 p.m.	5.44 p.m.	0.80	5.18 p.m.	5.29 p.m.	0.03	0.41	0.68	0.76	0.77										
Memphis, Tenn.	24			2.05														1.00‡			
Meridian, Miss.	27	7.27 a.m.	6.02 p.m.	2.40	7.35 a.m.	8.03 a.m.	0.04	0.12	0.39	0.59	0.72	0.84	0.89	0.94	0.98	1.01	1.05	1.09			
Milwaukee, Wis.	3			0.53						0.43											
Montgomery, Ala.	19	6.30 p.m.	7.25 p.m.	0.88	6.34 p.m.	6.51 p.m.	T.	0.28	0.56	0.76	0.82	0.84									
	20-21	10.45 p.m.	2.20 a.m.	4.00	10.50 p.m.	12.45 a.m.	0.05	0.14	0.26	0.36	0.53	0.69	0.92	1.16	1.37	1.59	1.89				
								2.18	2.36	2.65	2.90	3.02	3.13	3.23	3.43	3.60	3.68	3.78	3.86	
	21	4.50 p.m.	7.30 p.m	1.02	5.05 p.m.	5.50 p.m.	0.05	0.16	0.41	0.64	0.69	0.74	0.77	0.79	0.83	0.90					
	22	3.48 p.m.	5.50 p.m.	1.61	3.55 p.m.	4.30 p.m.	T.	0.17	0.39	0.49	0.79	1.21	1.46	1.52							
	23	12.25 p.m.	5.10 p.m.	1.59	2.10 p.m.	2.40 p.m.	0.14	0.20	0.54	0.81	1.03	1.12	1.19	1.21							
	25	5.57 p.m.	7.00 p.m.	1.07	5.57 p.m.	6.25 p.m.	0.00	0.15	0.35	0.64	0.84	1.02	1.06								
Nantucket, Mass.	26			0.46														0.37			
Nashville, Tenn.	23	7.28 a.m.	10.15 a.m.	1.22	7.30 a.m	7.58 a.m.	T.	0.20	0.40	0.59	0.69	0.81	0.90								
New Orleans, La.	25	9.10 a.m.	3.05 p.m.	2.61	11.18 a.m.	12.20 p.m.	0.96	0.24	0.50	0.65	0.71	0.81	0.84	0.90	0.98	1.04	1.15	1.32			
New York, N. Y.	8	5.08 p.m.	10.42 p.m.	2.49	7 00 p.m	8.20 p.m.	0.58	0.07	0.17	0.21	0.32	0.48	0.64	0.81	0.94	1.04	1.13	1.23	1.68		
	12	7.09 p.m.	8.45 p.m.	1.51	7.11 p.m.	8.20 p.m.	T.	0.20	0.45	0.60	0.71	0.81	0.89	0.96	1.06	1.08	1.08	1.20	1.51		
Norfolk, Va.	8	9.00 p.m.	9.55 p.m.	0.78	9.15 p.m.	9.42 p.m.	0.02	0.10	0.22	0.44	0.62	0.72	0.75								
	17	4.45 p.m.	7.50 p.m	0.62	4.51 p.m.	5.06 p.m.	T.	0.12	0.33	0.46	0.47										
Northfield, Vt.	6			0.48										0.37							
Oklahoma, Okla.	21	8.50 p.m.	10.40 p.m.	1.57	8.52 p.m.	9.50 p.m.	T.	0.14	0.27	0.29	0.35	0.44	0.65	0.79	1.02	1.22	1.30	1.46			
	22	D. N.	D. N.	0.92	3.22 a.m.	3.45 a.m.	T.	0.42	0.70	0.82	0.90	0.91									
Omaha, Nebr.	31			0.29								0.27									
Parkersburg, W. Va.	29-30	10.05 p.m.	7.50 a.m.	1.06	2.35 a.m.	3.00 a.m.	0.25	0.21	0.54	0.66	0.73	0.76									
Philadelphia, Pa.	26	2.10 a.m.	6.30 a.m.	1.40	2.50 a.m.	3.10 a.m.	0.12	0.13	0.33	0.56	0.67	0.70	0.72								
Pittsburg, Pa.	17			0.42														0.32			
Pocatello, Idaho	11			0.06														0.05			
Portland, Me.	26	8.15 a.m.	12.40 p.m.	2.05	9.25 a.m.	10.50 a.m.	0.19	0.10	0.27	0.38	0.49	0.56	0.74	0.91	0.98	1.07	1.15	1.27	1.58	1.74	
Portland, Oreg.	21			0.47														0.32			
Raleigh, N. C.	16	6.55 p.m.	7.35 p.m.	0.72	7.00 p.m.	7.20 p.m.	T.	0.25	0.56	0.65	0.69										
	28	2.40 p.m.	3.25 p.m.	0.75	2.50 p.m.	3.05 p.m.	0.04	0.08	0.30	0.59	0.61	0.66	0.71								
	30	7.45 p.m.	11.30 p.m.	1.07	7.48 p.m.	8.20 p.m.	T.	0.12	0.20	0.44	0.54	0.68	0.73	0.75							
Richmond, Va.	30			0.67												0.67					
Rochester, N. Y.	8			0.56														0.40			
St. Louis, Mo.	4-5	11.33 a.m.	1.15 a.m.	1.27	12.50 p.m.	1.05 p.m.	0.12	0.15	0.45	0.79											
	16	5.20 p m	6.50 p.m.	1.02	6.04 p.m.	6.40 p.m.	T.	0.05	0 24	0.45	0.57	0.77	0.94	0.99	1.01						
	24	11.44 a.m.	6.30 p.m.	1.14	12.03 p.m.	12.20 p.m.	T.	0.09	0.27	0.44	0.78	1.10	1.12								
St. Paul, Minn.	12			0.52														0.51			
Salt Lake City, Utah.	14			0.27														*			
San Diego, Cal.†																					
San Francisco, Cal.†																					
Savannah, Ga.	8-9	10.25 p.m.	D. N.	1.60	11.03 p.m.	11.59 p.m.	0.07	0.22	0.35	0.40	0.44	0.59	0.64	0.70	0.78	0.83	0.90	0.99			
Seattle, Wash.	29			0.14														0.11			
Spokane, Wash.	30-31			0.17									0.09								
Tampa, Fla.	1	4.24 p.m.	6.40 p.m.	0.95	4.25 p.m.	4.40 p.m.	T.	0.15	0.63	0.77	0.80										
	2	1.16 p.m.	7.15 p.m.	1.46	3.05 p.m.	3.25 p.m.	0.56	0.25	0.45	0.62	0.80										
	23	7.55 p.m.	8.45 p.m.	1.30	8.00 p.m.	8.30 p.m.	0.10	0.35	0.55	0.60	0.70	0.80	0.85	0.90							
	24-25	10.55 p m	4.40 p.m.	4.23	8.00 a.m.	9.00 a.m.	1.94	0.05	0.16	0.30	0.41	0.47	0.51	0.57	0.62	0.69	0.77	0.85			
Vicksburg, Miss.	23	9.30 p m	10.50 p.m.	1.12	9.35 p.m.	10.00 p.m.	T.	0.04	0.24	0.69	0.98	1.06	1.07	1.09	1.11						
Washington, D. C.	5	10.55 a.m.	12.20 p.m.	1.27	11.02 a.m.	11.28 a.m.	T.	0.15	0.50	0.80	0.87	0.93									
	16	6.50 p.m.	8.10 p.m.	0.79	6.50 p.m.	7.25 p.m.	0.00	0.15	0.34	0.43	0.43	0.48	0.54	0.66							
	25-26	8.15 p.m.	8 30 a.m.	1.22	11.10 p.m.	1.05 a.m.	0.07	0.12	0.26	0.33	0.43	0.56	0.65	0.69	0.74	0.81	0.87	0.92			
	26	3.00 p.m.	4.02 p.m.	0.85	3.04 p.m.	3.30 p.m.	T.	0.18	0.45	0.67	0.77	0.80									

TABLE IX.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration.		Total am't of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time as indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Wilmington, N. C.	21	3.30 a. m.	8.20 a. m.	1.96	4.37 a. m.	5.30 a. m.	0.11	0.12	0.26	0.32	0.40	0.54	0.69	0.77	0.81	0.85	0.92	0.99	.....	.....	.....
Yankton, S. Dak.	12	.....	.....	1.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.46	.....	.....	.....
Basseterre, St. Kitts	1	.....	.....	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.42	.....	.....	.....	.....	.....	.....
Bridgetown, Barbados	31	.....	.....	0.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.37	.....	.....	.....
Cienfuegos, Cuba	19	5.00 p. m.	7.30 p. m.	1.49	6.00 p. m.	7.05 p. m.	0.06	0.05	0.21	0.28	0.32	0.39	0.41	0.47	0.50	0.79	1.12	1.34	1.42	.....	.....
Havana, Cuba	23	4.25 p. m.	5.40 p. m.	1.23	4.30 p. m.	5.35 p. m.	0.01	0.06	0.25	0.34	0.36	0.45	0.53	0.56	0.58	0.64	0.78	1.14	1.22	.....	.....
	24	1.52 p. m.	3.17 p. m.	1.30	1.52 p. m.	2.30 p. m.	0.00	0.14	0.45	0.79	1.02	1.17	1.22	1.25	.....	.....	.....	.....	.....	.....	.....
Kingston, Jamaica	11	12.30 a. m.	4.00 a. m.	0.06	12.32 a. m.	1.00 a. m.	T.	0.13	0.18	0.28	0.49	0.57	0 60	.....	.....	.....	.....	.....	.....	.....	.....
Port of Spain, Trin.	8	10.45 a. m.	1.30 p. m.	1.23	10.50 a. m.	11.45 a. m.	T.	0.08	0.16	0.23	0.33	0.37	0.42	0.52	0.71	0.78	.....	.....	.....	.....	.....
Puerto Principe, Cuba	20	2.46 p. m.	5.20 p. m.	0.75	2.46 p. m.	3.00 p. m.	0.00	0.28	0.53	0.59	0.60	0.63	0.67	0.71	.....	.....	.....	.....	.....	.....	.....
Roseau, Dominica, W. I.	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Juan, Porto Rico	27	12.05 p. m.	1.44 p. m.	1.76	12.24 p. m.	1.05 p. m.	0.14	0.33	0.64	0.75	0.76	0.92	1.36	1.50	1.60	.....	.....	.....	.....	.....	.....
	28	5.44 a. m.	7.04 a. m.	0.82	6.30 a. m.	7.00 a. m.	0.01	0.07	0.20	0.29	0.48	0.78	0.81	.....	.....	.....	.....	.....	.....	.....	.....
Santiago de Cuba	28	.....	.....	0.45	.....	.....	.....	.....	.....	0.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Santo Domingo	25	1.15 p. m.	2.05 p. m.	0.86	1.17 p. m.	1.35 p. m.	T.	0.32	0.44	0.69	0.82	0.83	.....	.....	.....	.....	.....	.....	.....	.....	.....
	28–29	10.40 a. m.	1.35 a. m.	4.21	6.35 p. m.	8.15 p. m.	1.73	0.06	0.18	0.21	0.25	0.27	0.30	0.34	0.46	0.66	0.68	0.80	1.05	1.32	1.43
Willemstad, Curaçao	21–22	.....	.....	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.48	.....	.....	.....

* Self-register out of order. † No precipitation during the month. ‡ Estimated.

TABLE X.—*Excessive precipitation, by stations, for July*, 1899.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Alabama.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Alco	11.59	4.65	10	.....	.....	.....
Do	.....	2.64	22	.....	.....	.....
Montgomery	13.42	5.27	20-21	3.81	1 53	20-21
Do	.....	3.10	22-23	1.50	0 38	22
Do	.....	.....	.....	1.09	0 23	23
Do	.....	.....	.....	1.05	0 28	25
Mount Willing	.....	3.00	22	.....	.....	.....
Talladega	.....	4.15	22	.....	.....	.....
Tuscaloosa	.....	2.52	26-27	.....	.....	.....
Wilson	12.99	3.13	21	1.00	0 25	5
Do	.....	.....	.....	1.50	0 35	8
Do	.....	2.90	21	2.90	0 45	21
Arizona.						
Oro Blanco	.....	.....	.....	1.20	0 50	31
Walnut Grove	.....	.....	.....	1.01	0 50	30
Arkansas						
Hardy	.....	3.38	21	.....	.....	.....
Hot Springs	.....	.....	.....	1.26	1 00	23
Little Rock	.....	2.83	21-22	1.12	0 39	30
Do	.....	.....	.....	1.16	0 55	22
Do	.....	.....	.....	1.40	0 40	22
Lonoke	10.12	5.51	22	.....	.....	.....
Marianna	.....	4.84	22	.....	.....	.....
New Gascony	.....	2.50	27	.....	.....	.....
Osceola	.....	.....	.....	1.22	1 00	23
Pond	.....	3.10	31	.....	.....	.....
Powell	.....	4.31	21	.....	.....	.....
Silver Springs	.....	5.18	20-21	.....	.....	.....
Washington	.....	.....	.....	1.08	1 00	17
Colorado.						
Rockyford	.....	.....	.....	2.08	1 00	13
Santa Clara	.....	.....	.....	1.08	0 30	12
Connecticut.						
Canton	.....	3.50	8	.....	.....	.....
Hartford	.....	3.71	8	.....	.....	.....
West Simsbury	.....	3.65	8	.....	.....	.....
Florida.						
Boca Raton	.....	2.80	24	.....	.....	.....
Brooksville	11.15	.....	.....	.....	.....	.....
Estero	14.93	3.65	23-24	.....	.....	.....
Eustis	13.55	3.45	2	.....	.....	.....
Do	.....	2.59	22	.....	.....	.....
Federal Point	11.25	2.70	6	2.70	2 00	6
Huntington	11.61	3.22	2	.....	.....	.....
Inverness	10.08	2.50	13	.....	.....	.....
Jacksonville	.....	.....	.....	1.08	0 25	11
Do	.....	.....	.....	1.00	0 48	19
Kissimmee	.....	2.59	21	.....	.....	.....
Manatee	24.45	8.30	23-25	1.73	1 35	7
Merritts Island	.....	.....	.....	1.36	0 55	20
Myers	12.08	3.67	2	.....	.....	.....
Pensacola	.....	2.61	24-25	1.09	1 00	24
Plant City	10.36	2.87	24-25	.....	.....	.....
St. Francis	12.97	4.74	22	.....	.....	.....
St. Francis Barracks	11.80	4.50	2-3	.....	.....	.....
Switzerland	12.86	2.82	4	2.82	2 30	4
Do	.....	4.57	21	.....	.....	.....
Tampa	15.53	3.73	22-23	1.00	0 51	23
Do	.....	5.16	24-25	1.30	0 38	23
Tarpon Springs	18.46	3.84	22	.....	.....	.....
Do	.....	4.67	24	.....	.....	.....
Georgia.						
Adairsville	.....	2.68	22	.....	.....	.....
Atlanta	.....	4.05	20	2.06	1 09	21
Augusta	.....	.....	.....	1.47	0 38	7
Carlton	.....	.....	.....	2.28	0 35	7
Clayton	.....	2.50	8	.....	.....	.....
Morgan	.....	2.70	24	.....	.....	.....
Tallapoosa	.....	3.76	20-21	.....	.....	.....
Illinois.						
Ashton	.....	.....	.....	1.70	1 00	3
Astoria	.....	.....	.....	1.53	1 00	11
Cairo	.....	.....	.....	1.01	0 47	21
Chemung	.....	2.70	4	.....	.....	.....
Equality	.....	3.33	22	3.33	1 00	22
Havana	.....	5.10	16	5.10	1 30	16
Lagrange	.....	4.95	15	.....	.....	.....
Martinsville	.....	.....	.....	1.90	1 10	27
Ottawa	.....	3.16	14-15	.....	.....	.....
Riley	.....	2.65	15	1.12	0 15	15
St. Charles	.....	4.46	15	.....	.....	.....
Scales Mound	.....	2.97	24	.....	.....	.....
Streator	.....	3.50	15	.....	.....	.....
Sycamore	.....	2.64	15	.....	.....	.....
Tilden	.....	.....	.....	1.67	1 00	7
Wheaton	.....	4.68	15	4.21	3 00	15
Indiana.						
Butlerville	.....	.....	.....	1.04	1 00	5
Greensburg	.....	.....	.....	2.41	2 00	25
Knightstown	.....	.....	.....	1.25	0 25	5
Scottsburg	.....	.....	.....	2.18	1 40	28
Indian Territory.						
Ryan	.....	2.72	18	.....	.....	.....
Sapulpa	.....	.....	.....	1.00	1 00	2
South McAlaster	.....	3.33	21-22	1.62	1 05	1
Tahlequah	.....	.....	.....	2.00	2 00	8
Wagoner	10.08	2.80	21	.....	.....	.....
Iowa.						
Alta	.....	.....	.....	1.42	1 10	5
Amana	.....	3.60	2-3	.....	.....	.....

TABLE X.—*Excessive precipitation*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Iowa—Continued.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Bedford	.....	3.60	2-3	.....	.....	.....
Chariton	.....	2.61	3	.....	.....	.....
Clinton	.....	.....	.....	1.40	1 05	25
Hawkeye	.....	2.50	12	.....	.....	.....
Knoxville	.....	3.37	3	.....	.....	.....
Mount Vernon	.....	2.60	3	.....	.....	.....
Ottumwa	.....	.....	.....	2.32	2 00	14
Pella	.....	3.58	3	.....	.....	.....
Woodburn	.....	2.73	2-3	.....	.....	.....
Kansas.						
Atchison	.....	2.53	7	.....	.....	.....
Augusta	.....	2.75	7	.....	.....	.....
Campbell	.....	3.58	28-29	.....	.....	.....
Centropolis	.....	2.50	7	.....	.....	.....
Chanute	10.05	4.12	4	.....	.....	.....
Do	.....	3.55	7	.....	.....	.....
Columbus	.....	2.64	4	.....	.....	.....
Dodge	.....	.....	.....	1.30	0 33	23
Eskridge	.....	4.00	6	.....	.....	.....
Eureka	.....	2.91	3-4	.....	.....	.....
Eureka Ranch	.....	3.00	2	.....	.....	.....
Fort Scott	.....	2.50	3-4	.....	.....	.....
Gove	.....	.....	.....	2.30	1 20	15
Grenola	.....	2.69	7	.....	.....	.....
Horton	.....	2.60	29	.....	.....	.....
Independence	11.44	2.88	21	.....	.....	.....
Lawrence	.....	3.67	6-7	.....	.....	.....
Lebo	.....	2.78	7	.....	.....	.....
Manhattan	.....	2.68	6-7	.....	.....	.....
Meade	.....	3.00	14	3.00	0 50	14
Morantown	.....	6.16	3-4	.....	.....	.....
Olathe	.....	2.80	7	.....	.....	.....
Osage City	.....	3.96	6	.....	.....	.....
Ottawa	.....	3.76	3	.....	.....	.....
Seneca	.....	2.85	28-29	.....	.....	.....
Topeka	.....	3.01	6-7	1.97	1 00	6
Toronto	10.15	3.60	4	.....	.....	.....
Do	.....	3.20	7	.....	.....	.....
Ulysses	.....	2.60	7	.....	.....	.....
Wamego	.....	3.20	6	2.95	2 00	6
Winona	.....	.....	.....	1.00	0 45	4
Do	.....	.....	.....	2.00	1 00	12
Yates Center	11.21	5.58	3-4	.....	.....	.....
Kentucky.						
Bardstown	.....	2.52	26	.....	.....	.....
Earlington	.....	3.48	21-22	.....	.....	.....
Hopkinsville	.....	2.57	23	.....	.....	.....
Loretto	.....	.....	.....	1.53	1 00	30
Marrowbone	.....	3.34	22	.....	.....	.....
Paducah	.....	2.90	22	.....	.....	.....
Louisiana.						
Bastrop	.....	3.10	24	.....	.....	.....
Batron Rouge	.....	.....	.....	1.28	1 00	27
Franklin	.....	3.10	18	.....	.....	.....
Hammond	.....	2.52	25	.....	.....	.....
Jeanerette	.....	3.10	9	.....	.....	.....
New Orleans	.....	2.61	25	1.32	1 00	25
Oakridge	.....	.....	.....	1.40	1 10	8
Opelousas	.....	.....	.....	2.24	1 30	4
Ruston	.....	.....	.....	1.05	1 00	18
Sugar Experiment Station	.....	3.10	25	2.10	1 30	2
Sugartown	.....	2.74	18	.....	.....	.....
White Sulphur Springs	.....	2.76	18	.....	.....	.....
Maine.						
Kineo	.....	2.50	7	.....	.....	.....
Portland	.....	.....	.....	1.21	0 53	26
Maryland.						
Boonsboro	.....	.....	.....	1.00	0 45	15
Cambridge	.....	3.20	16	.....	.....	.....
Jewell	.....	.....	.....	1.29	1 00	8
Pocomoke City	.....	2.95	26-27	.....	.....	.....
Massachusetts.						
Leeds	.....	.....	.....	1.27	1 00	8
Monson	.....	2.80	8	.....	.....	.....
Pittsfield	.....	2.58	25	.....	.....	.....
Springfield Armory	.....	2.68	8-9	.....	.....	.....
Michigan.						
Bay City	.....	3.80	5	.....	.....	.....
Big Rapids	10.62	3.48	4	2.42	2 00	7
Detroit	.....	.....	.....	1.00	0 42	21
Menominee	.....	.....	.....	1.25	1 00	25
Mount Pleasant	.....	3.00	3-4	.....	.....	.....
Reed City	.....	2.50	4	.....	.....	.....
Minnesota.						
Bird Island	.....	.....	.....	1.00	0 50	14
Grand Meadow	.....	3.40	12	.....	.....	.....
Moorhead	.....	.....	.....	1.32	1 10	5
Mississippi.						
Austin	.....	5.35	22	.....	.....	.....
Batesville	10.49	7.80	22-23	.....	.....	.....
Brookhaven	.....	2.65	27	.....	.....	.....
Greenwood	.....	2.90	4	.....	.....	.....
Logtown	.....	.....	.....	1.43	1 00	1
Meridian	.....	3.04	26-27	1.01	0 42	27
Pontotoc	.....	2.52	23	.....	.....	.....
Vicksburg	.....	.....	.....	1.01	0 18	23
Water Valley	.....	3.88	23	.....	.....	.....
Missouri.						
Appleton City	.....	2.78	3-4	.....	.....	.....
Columbia	.....	.....	.....	1.02	0 50	

TABLE X.—*Excessive precipitation.*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Missouri—Continued.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Conception		3.55	14			
Cowgill		3.36	3			
Fulton				1.80	1 30	15
Do				1.55	0 30	31
Hannibal				1.00	0 30	4
Hazlehurst				1.00	0 20	31
Oakfield		2.76	4			
Oregon		4.48	28-29			
Poplarbluff		3.00	22	3.00	1 00	22
St. Louis				1.01	0 37	16
Do				1.11	0 25	24
Shelbina		2.50	31			
Montana.						
Glendive		3.00	31	3.00	1 00	31
Nebraska.						
Agee		3.25	2			
Ansley				1.25	1 00	5
Auburn		3.05	6			
Beatrice		2.50	7			
Beaver City		3.00	28	2.50	1 00	28
Brokenbow		2.85	26-27	1.70	1 00	12
Columbus		2.69	16	2.69	2 00	16
Dawson		2.44	6	1.51	0 20	6
Eden		3.23	7-8			
Kirkwood				1.20	1 00	31
Nesbit		2.52	26			
Republican		2.57	28			
Salem		4.05	28			
Seward		2.77	2			
Tablerock		3.35	28-29			
Tecumseh		2.72	6			
Thedford				2.03	1 30	13
Wallace		2.60	28			
Wellfleet				1.29	1 00	2
Wilsonville		2.60	28			
New Hampshire.						
Grafton				1.60	1 00	21
Littleton				1.00	0 45	21
New Jersey.						
Atlantic City		2.87	26	1.00	1 00	26
Beverly				1.11	0 45	8
Do				1.34	0 45	30
Bridgeton		2.89	26	1.75	1 00	6
Do				1.69	1 00	26
Clayton		2.62	26			
Egg Harbor City		2.90	26			
Hammonton		3.38	25-26			
Mount Pleasant		4.95	26			
Trenton				1.50	0 30	22
Ocean City		2.90	26			
Paterson				1.50	1 00	8
Staffordville		4.80	26-27			
Tuckenton		3.70	26			
Vineland		2.77	26			
New Mexico.						
Albuquerque		3.00	18			
Clayton	10.51	4.03	18			
Gallinas Spring		3.25	19			
Raton		3.50	17			
Roswell				1.33	0 30	19
New York.						
Bedford		2.94	8			
Brentwood				1.00	1 00	23
Garrattsville		4.72	8-9			
Hemlock Lake				1.10	0 30	25
Honeymead Brook		1.35	8-9			
Liberty		2.50	26			
New York		2.50	8	1.87	1 43	8
Do				1.07	0 41	12
Oxford		2.90	8			
Port Jervis	10.49	4.45	29-30			
North Carolina.						
Experimental Farm				1.02	1 00	23
Greenville	10.23	2.70	30			
Hatteras		3.60	23	2.15	1 00	23
Do		3.11	24-25			
Henderson		2.58	4			
Hendersonville		2.52	25			
Louisburg				1.00	0 20	30
Mana		2.66	26			
Moncure		2.67	26			
Morganton		2.60	26			
Roxboro		3.04	7			
Selma	12.15					
Sloan	11.16	6.49	25			
Southern Pines	10.65					
Weldon	10.27	5.03	26-27			
Wilmington		2.60	24-25			
North Dakota.						
Dickinson				1.05	0 50	14
Donnybrook		2.50	5			
Dunseith		3.08	22			
Sheyenne		3.20	5			
Ohio.						
Camp Dennison				1.46	0 30	25
Dupont		2.80	15			
Seaman		2.65	25	2.65	0 30	25
Oklahoma.						
Beaver		2.60	23-24			

TABLE X.—*Excessive precipitation*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Oklahoma—Continued.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Clifton				1.45	1 00	19
Fort Sill	14.00	7.60	17			
Hennessey		2.80	20			
Kingfisher				1.76	1 40	15
Oklahoma				1.00	0 31	21
Pawhuska		4.27	7	4.27	2 30	7
Perry		2.58	19			
Prudence		3.73	20			
Sac and Fox Agency				2.00	1 15	15
Waukomis		3.35	7			
Winnview		5.10	20			
Pennsylvania.						
Greensburg				1.50	0 40	8
Hamburg				1.60	1 00	16
Parker		2.50	25			
Philadelphia				1.16	1 00	27
Scranton				1.42	1 00	5
Shinglehouse				1.19	0 40	29
Selsholtzville		3.43	8			
South Carolina.						
Clemson College		2.63	26			
Georgetown		2.75	25			
Santuck		4.33	26			
Summerville		3.10	19			
Temperance	10.16	3.00	6			
South Dakota.						
Aberdeen		2.50	4			
Canton		3.71	5			
Kimball				1.12	0 20	5
Mitchell				2.00	1 00	5
Tyndall		2.57	13			
Tennessee.						
Erasmus		2.73	26	2.52	0 50	26
Franklin		2.55	24			
Harriman				1.70	0 40	28
Johnsonville		2.53	22			
Lewisburg		2.85	25-26			
Madison				1.53	0 40	23
Memphis				1.00	1 00	24
Nashville		3.39	22-23	1.25	1 00	24
Oakhill				2.15	2 00	17
Trenton				1.69	1 15	22
Waynesboro		4.00	22-23			
Texas.						
Alvin	12.70	8.82	26	8.82	5 30	26
Amarillo		2.94	7-8	1.11	0 54	18
Arthur				2.00	1 30	2
Austin		2.50	1			
Duval		4.64	1			
Fort Clark		2.81	3			
Gainesville				1.56	0 45	4
Galveston		4.02	26-27			
Grapevine				1.75	1 00	4
Hale Center		2.50	18			
Hulen		2.70	27			
Jacksonville				1.19	0 15	1
Do				1.29	0 45	2
Mann				1.45	0 55	18
Mount Blanco		3.02	20			
New Braunfels		2.74	1			
Palestine				1.40	0 50	2
Rhineland		4.10	1			
Sugarland		4.02	27			
Victoria		2.70	27			
Utah.						
Heber				1.00	1 00	11
Vermont.						
Bennington		2.61	8-9			
Burlington		3.32	9			
Virginia.						
Bigstone Gap		3.40	25			
Rockymount		2.80	26			
Salem				1.12	0 40	30
Speers Ferry		3.92	25-26			
Sunbeam		3.05	26-27			
West Virginia						
Elkins				1.00	0 44	28
Wisconsin.						
Amherst		2.50	19			
Beloit		2.50	3			
Gratiot		3.10	3			
Lancaster		2.97	14			
New London				1.00	0 30	10
Racine		2.80	4			
Shawano				1.50	0 40	10
Porto Rico.						
Adjuntas	10.34			2.17	1 30	24
Canovanas	10.20					
Cidra	11.45					
Corozal	13.69					
Luquillo	10.60					
Manati		3.83	27			
Mayaguez	14.41					
San Juan		3.60	27-28	1.56	0 40	27
Cuba.						
Cienfuegos				1.34	1 00	19
Havana		2.77	23-24	1.19	1 00	23
Do				1.21	0 25	24

TABLE XI.—*Data furnished by the Canadian Meteorological Service, July*, 1899.

Stations.	Pressure.			Temperature.				Precipitation.			Stations.	Pressure.			Temperature.				Precipitation.		
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Depth of snow.		Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Depth of snow.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*		*Ins.*	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F.	29.80	29.94	—.04	57.8	— 1.5	66.3	49.4	3.81	.....		Saugeen, Ont.	29.27	29.96	+.03	64.3	— 0.4	73.4	55.1	3.84	+1.81	
Sydney, C. B. I.	29.90	29.94	+.03	63.3	+ 1.0	73.2	53.4	4.26	—0.24		Parry Sound, Ont	29.26	29.94	+.02	64.6	— 1.4	74.1	55.0	2.87	+0.44	
Halifax, N. S.	29.86	29.97	+.05	63.0	— 0.4	72 3	53.8	5.75	+1.50		Port Arthur, Ont.	29.24	29.92	+.03	61.8	— 0.2	73.1	50.5	3.52	+0.51	
Grand Manan, N. B.	29.88	29.93	—.02	60.8	— 0.9	68.2	53.3	5.76	+1.92		Winnipeg, Man.	29.10	29.90	.00	66.6	+ 0.6	79.0	54.2	1.96	—1.26	
Yarmouth, N. S.	29.89	29.97	+.04	60.4	+ 0.9	67.5	53.3	7.08	+4.01		Minnedosa, Man.	28.16	29.91	+ 06	65.4	+ 3.2	78.7	52.1	1.14	—1.40	
Charlottet'n, P. E. I.	29.87	29.91	—.01	65.6	+ 1.5	74.0	57.3	5.05	+1.08		Qu'Appelle, Assin.	27.71	29.89	+.02	64.2	+ 0.7	77.0	51.4	1.57	—0.88	
Chatham, N. B.	29.87	29.89	+.01	64.9	— 0.1	74.1	55.7	6.15	+1.45		Medicine Hat, Assin.	27.69	29.90	+.05	68.1	+ 0.3	82.0	54.2	3.79	+2.07	
Father Point, Que.	29.82	29.85	.00	56.0	— 1.6	65.0	47.0	4.61	+1.39		Swift Current, Assin.	27.44	29.93	+.02	65.9	— 0.6	78.9	52.9	3.95	+1.83	
Quebec, Que.	29 56	29.88	+.01	65.6	+ 0.1	75.4	55.9	5.16	+1.20		Calgary, Alberta	26.51	29.96	+.05	60.3	— 0.3	74.1	46.5	2.11	—0.47	
Montreal, Que.	29.68	29.88	.00	68.3	— 0.2	76.6	60.0	7.72	+3.15		Banff, Alberta	25.44	29.98	.....	56.6	.....	72.2	40.9	2.70	.....	
Bissett, Ont.	29.34	29.94	+.05	63.0	— 1.6	75.5	50.6	4.94	+1.82		Edmonton, Alberta	27.68	29.91	.00	61.4	+ 0.8	74.5	48.4	2.36	—0.74	
Ottawa, Ont.	29.58	29.89	.....	67.7	— 1.8	77.5	58.0	7.62	.....		Prince Albert, Sask.	28.37	29.87	.....	62.3	+ 0.4	73.9	50.6	4.86	.....	
Kingston, Ont.	29.62	29.93	+.03	67.6	— 1.0	76.0	59.2	1.42	—1.84		Battleford, Sask.	28.23	29.91	.....	64.8	+ 0.1	77.6	52.1	2.21	.....	
Toronto, Ont.	29.57	29.94	.00	69.3	+ 1.3	80.6	57.9	1.03	—1.94		Kamloops, B. C.	28.69	29.92	. ....	69.1	.....	82.4	55.8	1.37	.....	
White River, Ont.	28.64	29.96	.00	59.7	+ 0.2	75.4	44.0	1.35	—1.96		Esquimalt, B. C.	29.99	30.02	.....	61.8	+ 1.8	73.7	49.9	0.18	.....	
Port Stanley, Ont	29.34	29.96	.00	67.8	0.0	78.2	57.4	1.67	—1.88		Hamilton, Bermuda.	30.00	30.16	+.05	79.5	— 1.1	85.0	74.0	5.67	.....	

Chart I.—Tracks of Centers of High Areas.—July, 1899.

Chart I. Tracks of Centers of High Areas. July, 1899.

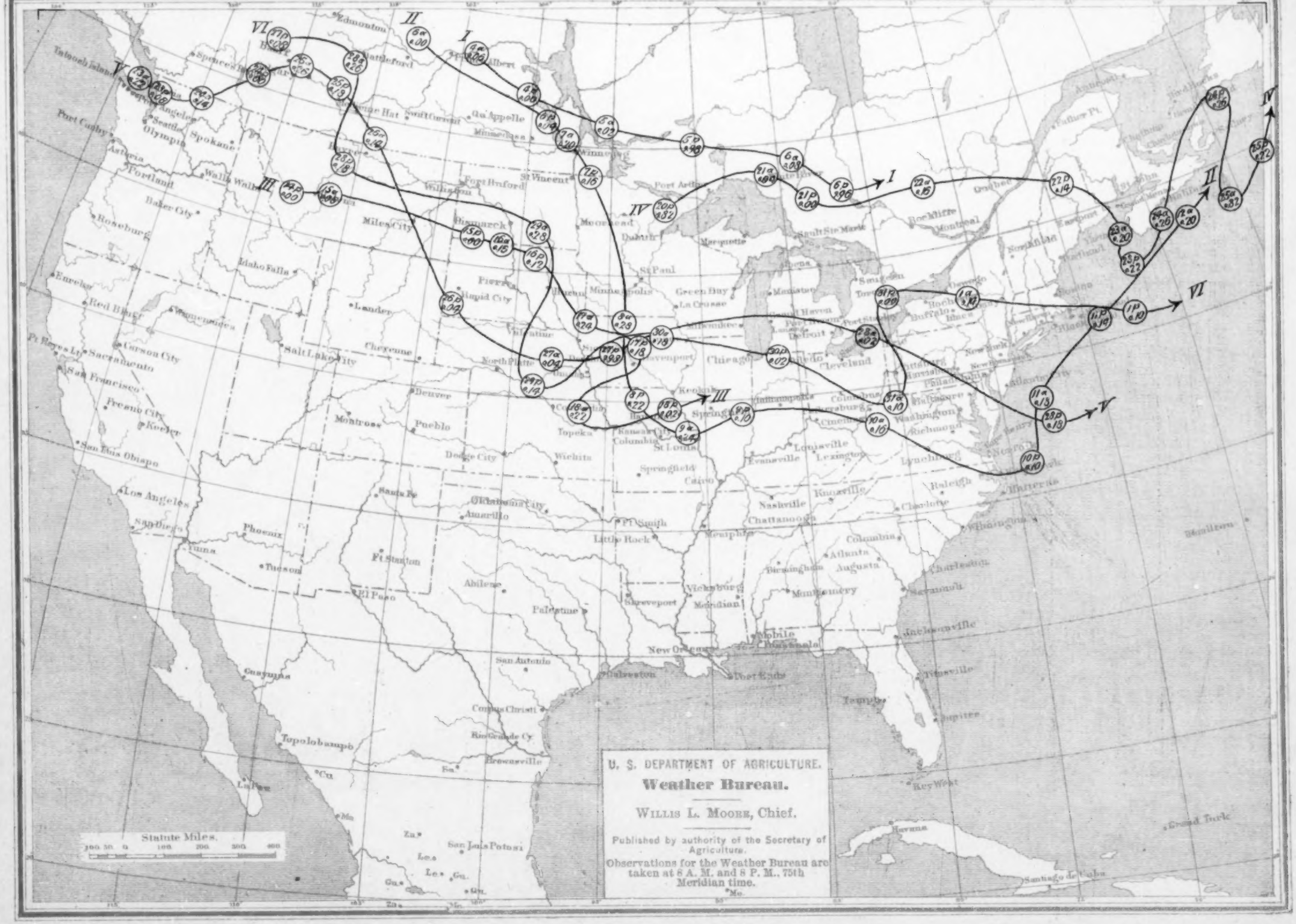

U. S. DEPARTMENT OF AGRICULTURE.
Weather Bureau.
WILLIS L. MOORE, Chief.
Published by authority of the Secretary of Agriculture.
Observations for the Weather Bureau are taken at 8 A. M. and 8 P. M., 75th Meridian time.
Statute Miles.
100 50 0 100 200 300 400
I
II
III
IV
V
VI
Edmonton
Prince Albert
Battleford
Swift Current
Medicine Hat
Minnedosa
Winnipeg
Port Arthur
Port Huron
Marquette
Duluth
Moorhead
St Vincent
Fort Buford
Williston
Bismarck
Miles City
Pierre
Rapid City
Huron
Minneapolis
St Paul
Green Bay
La Crosse
Milwaukee
Chicago
Detroit
Cleveland
Buffalo
Rochester
Ithaca
Toronto
Montreal
Quebec
Boston
New York
Philadelphia
Atlantic City
Washington
Richmond
Norfolk
Cincinnati
Columbus
Indianapolis
Springfield
Cairo
Evansville
Louisville
Lexington
Nashville
Knoxville
Chattanooga
Memphis
Little Rock
Ft Smith
Kansas City
St Louis
Topeka
Wichita
Dodge City
Oklahoma City
Amarillo
Abilene
Palestine
Shreveport
Vicksburg
Meridian
Mobile
New Orleans
Galveston
Port Eads
San Antonio
Corpus Christi
Rio Grande Cy
Brownsville
Monroe
Pueblo
Denver
Cheyenne
North Platte
Omaha
Salt Lake City
Idaho Falls
Pocatello
Helena
Miles City
Havre
Medicine Hat
Calgary
Edmonton
Battleford
Prince Albert
Winnipeg
Port Arthur
Duluth
Marquette
Sault Ste Marie
Toronto
Montreal
Quebec
Boston
New York
Philadelphia
Atlantic City
Washington
Richmond
Norfolk
Raleigh
Charlotte
Wilmington
Hatteras
Charleston
Savannah
Jacksonville
Tampa
Jupiter
Key West
Havana
Grand Turk
Santiago de Cuba
Atlanta
Augusta
Birmingham
Montgomery
Columbia
Knoxville
Nashville
Chattanooga
Memphis
Little Rock
Ft Smith
Kansas City
St Louis
Springfield
Cairo
Evansville
Louisville
Lexington
Cincinnati
Columbus
Indianapolis
Toledo
Cleveland
Buffalo
Rochester
Ithaca

Chart II. Tracks of Centers of Low Areas. July, 1899.

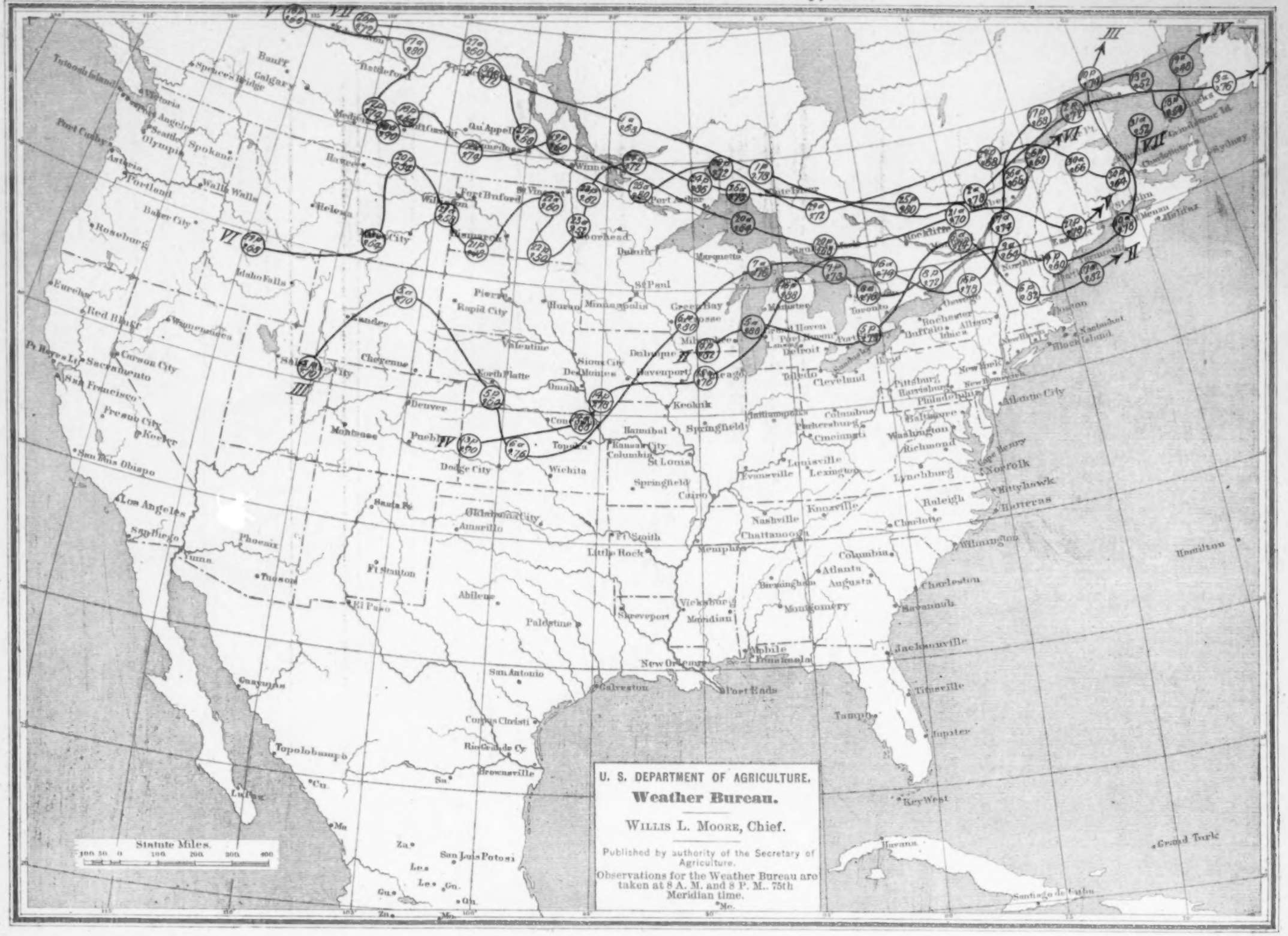


Chart III. Total Precipitation. July, 1899.

Chart III. Total Precipitation. July, 1899.

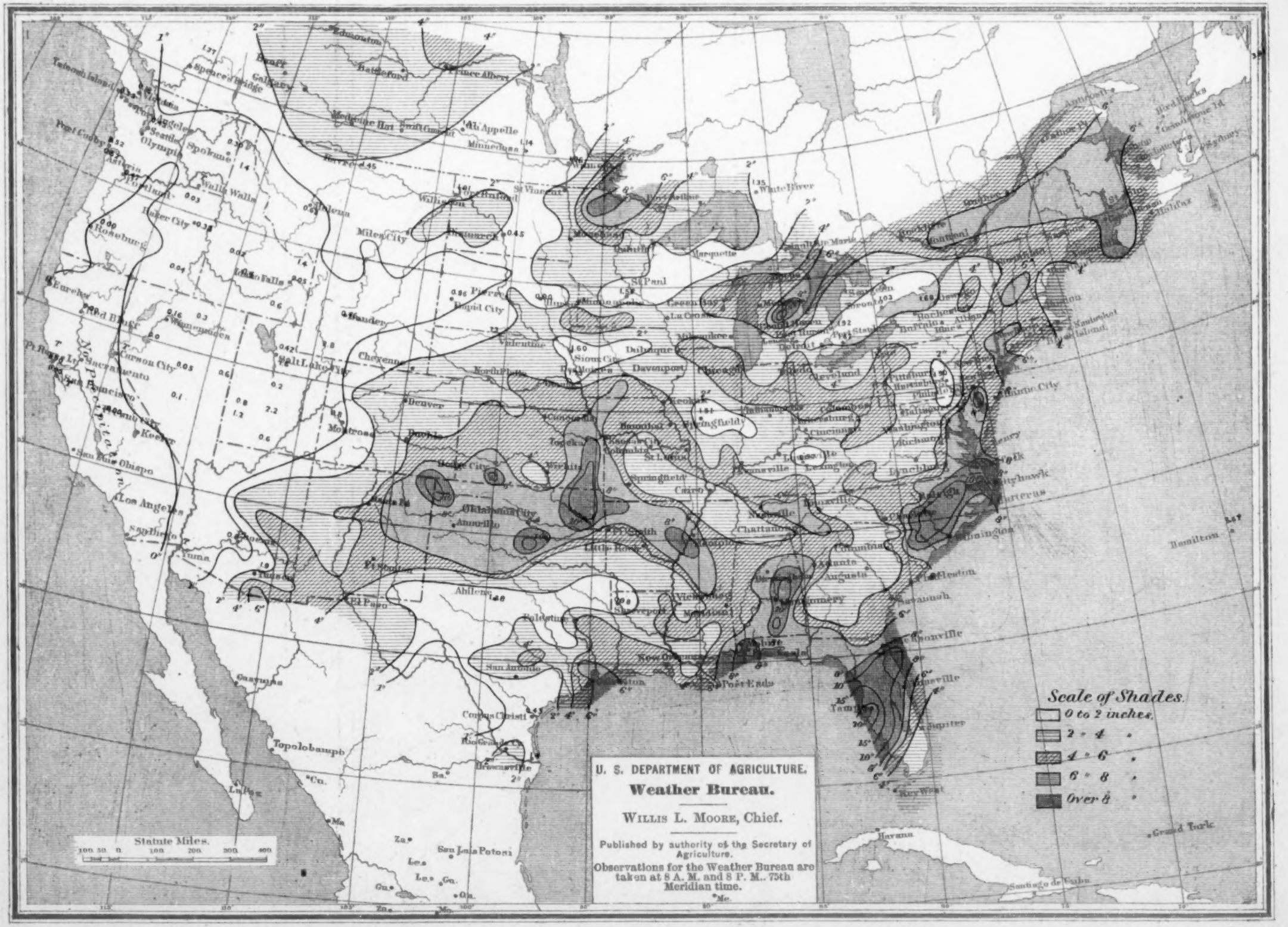

Scale of Shades.
0 to 2 inches.
2 " 4 "
4 " 6 "
6 " 8 "
Over 8 "
Statute Miles.
100 50 0 100 200 300 400
U. S. DEPARTMENT OF AGRICULTURE.
Weather Bureau.
WILLIS L. MOORE, Chief.
Published by authority of the Secretary of Agriculture.
Observations for the Weather Bureau are taken at 8 A. M. and 8 P. M., 75th Meridian time.

Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. July, 1899.

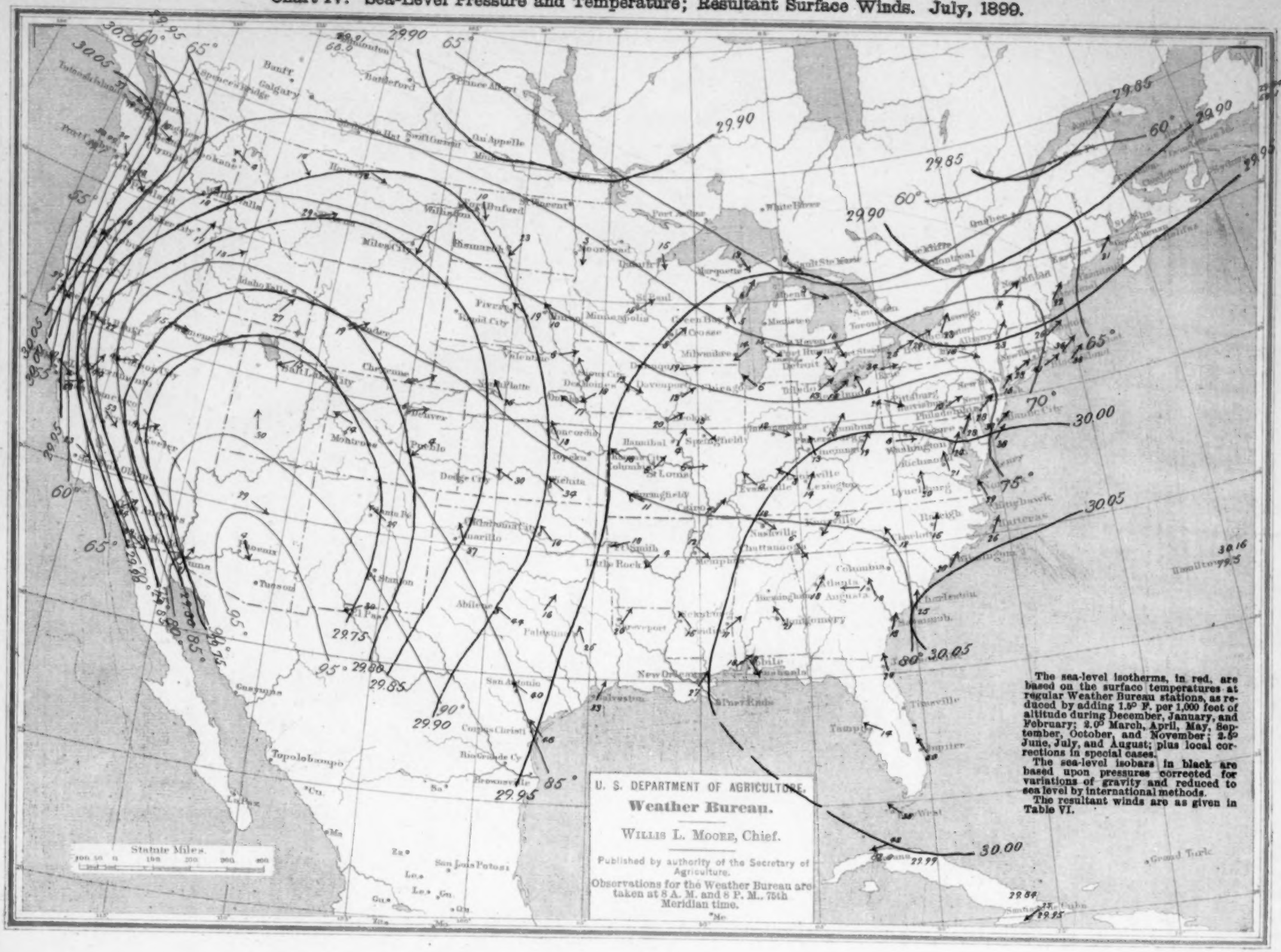

Statute Miles
100 50 0 100 200 300 400
U. S. DEPARTMENT OF AGRICULTURE.
Weather Bureau.
WILLIS L. MOORE, Chief.
Published by authority of the Secretary of Agriculture.
Observations for the Weather Bureau are taken at 8 A. M. and 8 P. M., 75th Meridian time.
The sea-level isotherms, in red, are based on the surface temperatures at regular Weather Bureau stations, as reduced by adding 1.5° F. per 1,000 feet of altitude during December, January, and February; 2.0° March, April, May, September, October, and November; 2.5° June, July, and August; plus local corrections in special cases.
The sea-level isobars in black are based upon pressures corrected for variations of gravity and reduced to sea level by international methods.
The resultant winds are as given in Table VI.

Chart V. Hydrographs for Seven Principal Rivers of the United States. July, 1899.

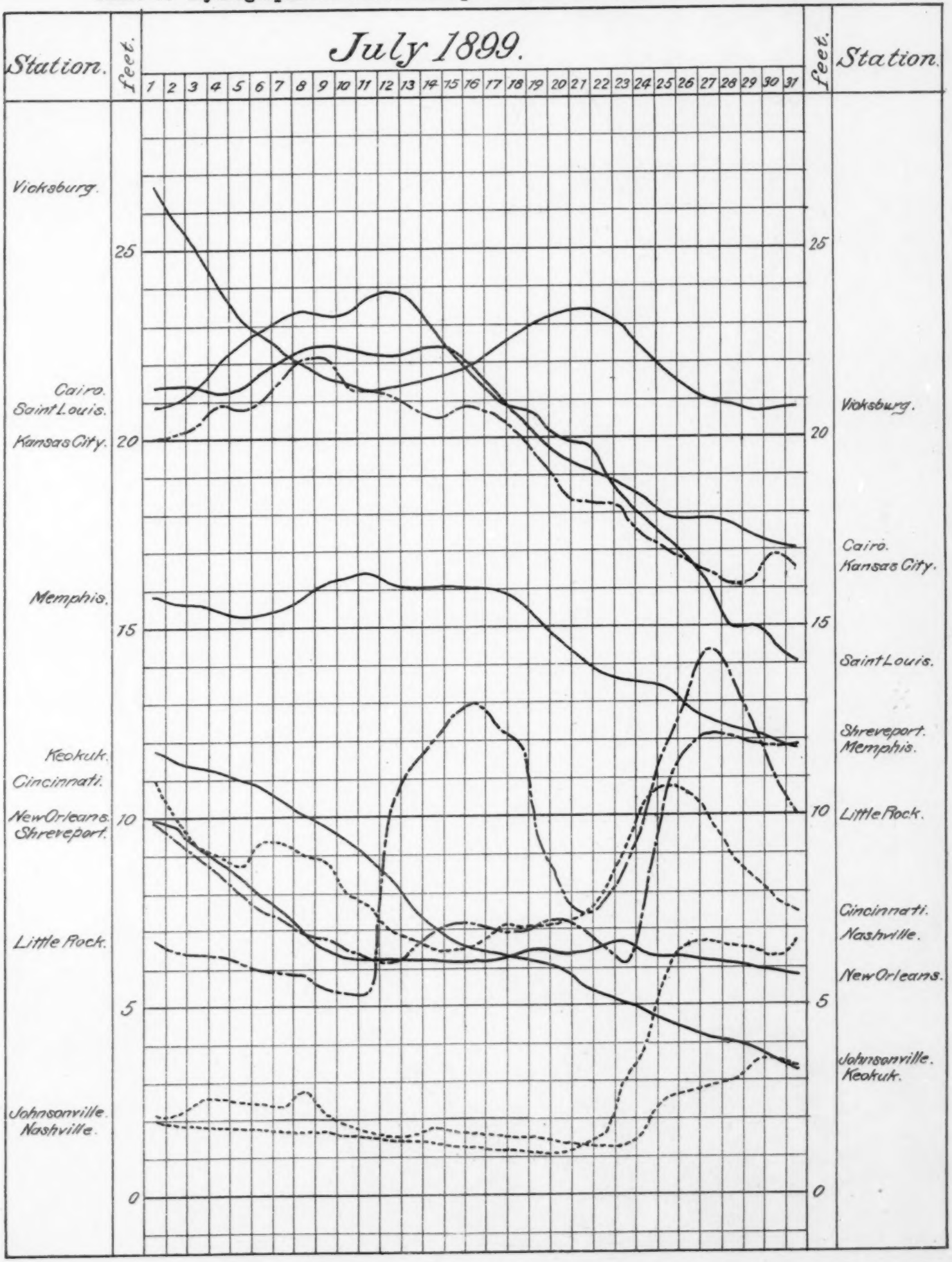


Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. July, 1899.

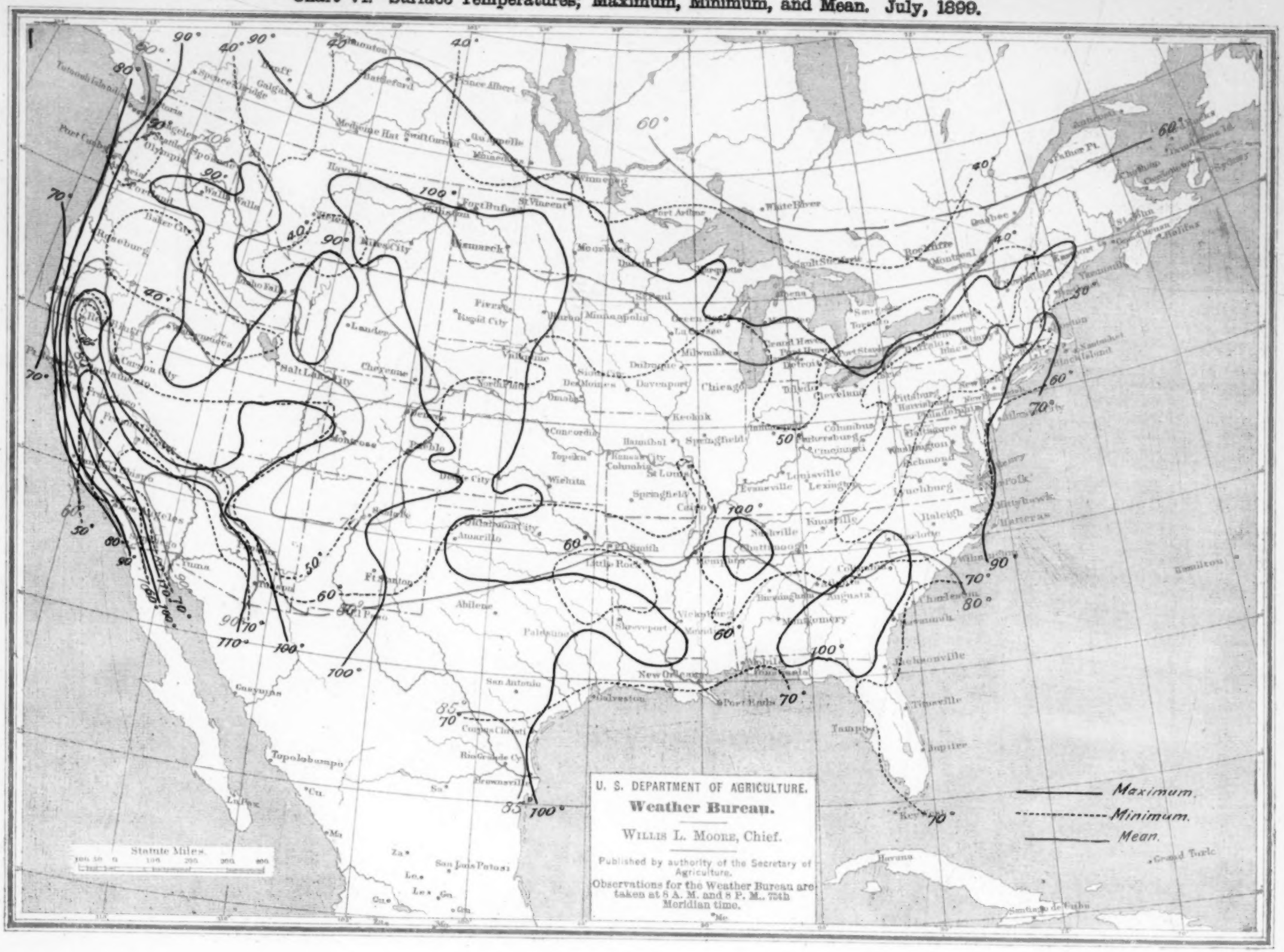

U. S. DEPARTMENT OF AGRICULTURE.
Weather Bureau.
WILLIS L. MOORE, Chief.
Published by authority of the Secretary of Agriculture.
Observations for the Weather Bureau are taken at 5 A. M. and 8 P. M., 75th Meridian time.
Maximum.
Minimum.
Mean.
Statute Miles.

Chart VII. Percentage of Sunshine. July, 1899.

Chart VII. Percentage of Sunshine. July, 1899.

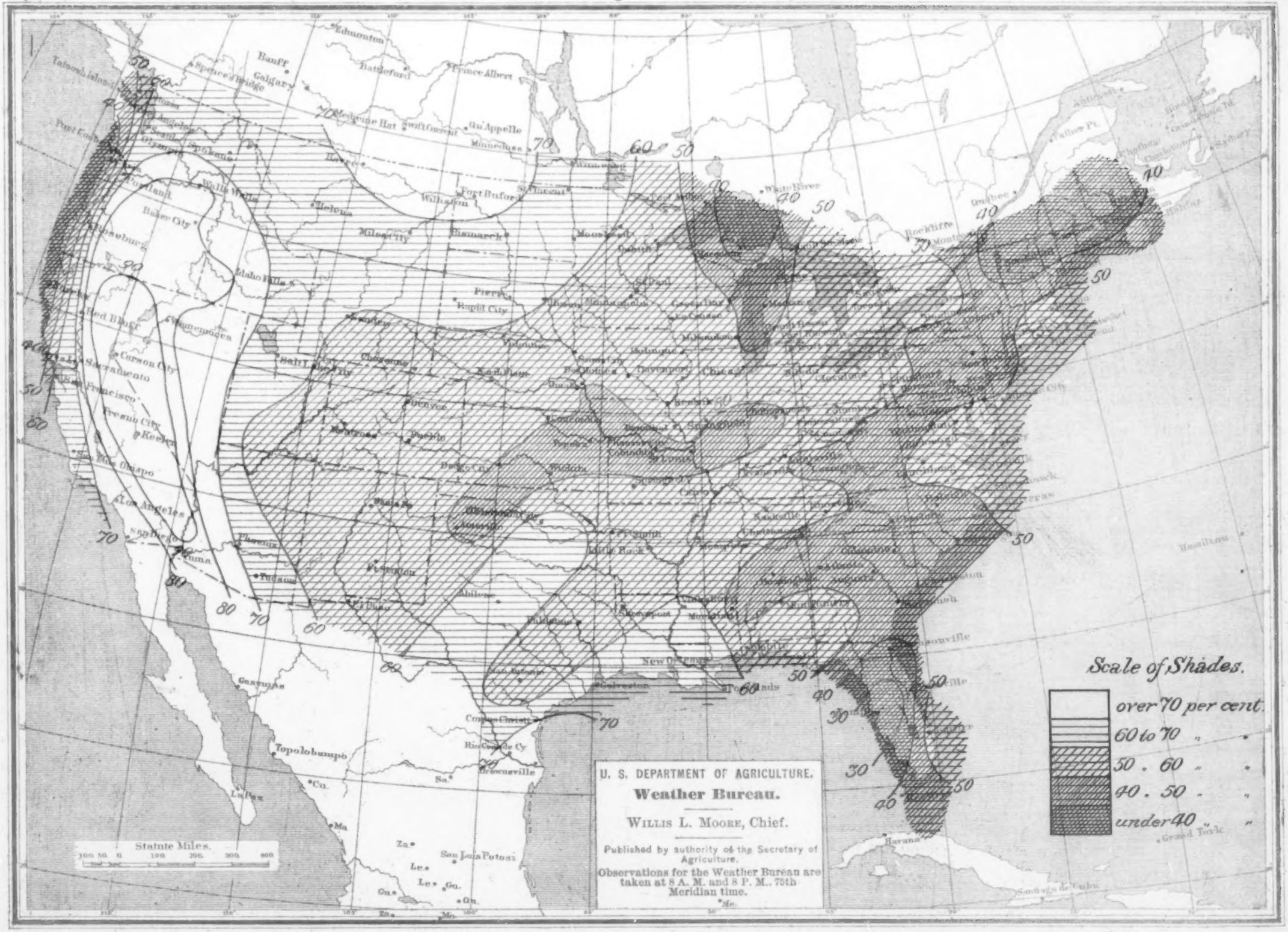


Chart VIII. West Indian Monthly Isobars, Isotherms, and Resultant Winds. July, 1899.

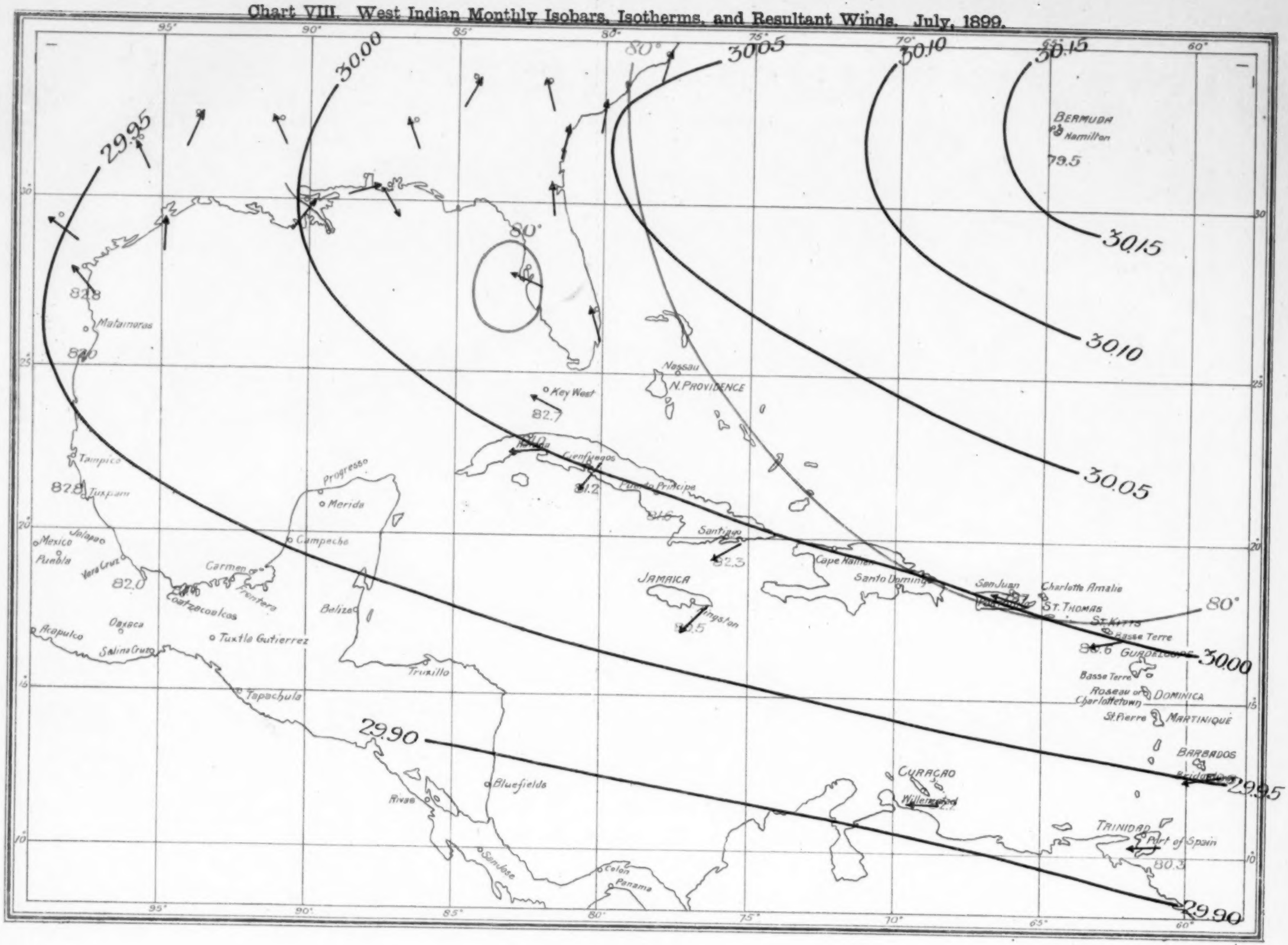


Plate I. Explosive Effects of the New Richmond Tornado.

Plate II. Explosive Effects of the New Richmond Tornado.

Plate III. Explosive Effects of the New Richmond Tornado.